REPORT RESUMES

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A GUIDE FOR USE IN DEVELOPING TRAINING PROGRAMS IN DRAFTING AND DESIGN TECHNOLOGY.

MISSISSIPPI STATE UNIV., STATE COLLEGE
MISSISSIPPI STATE DEPT. OF EDUCATION, JACKSON

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INITIAL COURSE OUTLINES WERE PREPARED BY INSTRUCTORS. INDIVIDUAL COURSES WERE THEN EXPANDED AND COORDINATED WITH OTHER COURSES. THE CURRICULUM LABORATORY STAFF REORGANIZED AND EDITED THE MATERIAL. A COMMITTEE OF INDUSTRIAL REPRESENTATIVES REVIEWED AND PERSONALLY ENDORSED IT AS BEING APPROPRIATE AND ADEQUATE FOR TRAINING DRAFTING AND DESIGN TECHNICIANS. THE CURRICULUM GUIDE COVERING 72 SEMESTER HOURS IS ARRANGED AS COURSE OUTLINES WHICH INCLUDE CONTENT TOPICS, CLASS AND LABORATORY HOURS, AND STUDENT ACTIVITIES. LISTED ARE 95 SUGGESTED TEXTS, DATED FROM 1943 TO 1964. STUDENTS SHOULD BE HIGH SCHOOL GRADUATES IN THE UPPER ONE-THIRD OF THEIR CLASS WITH TECHNICAL APTITUDES AND A MATH AND SCIENCE BACKGROUND. INSTRUCTORS SHOULD BE NO LESS THAN TECHNICAL SCHOOL GRADUATES WITH OCCUPATIONAL EXPERIENCE. COURSES INCLUDE (1) FUNDAMENTALS OF DRAFTING, (2) DESCRIPTIVE GEOMETRY, (3) MACHINE DRAFTING, (4) ELECTRICAL, PIPING, AND SHEET METAL DRAFTING, (5) ARCHITECTURAL DRAFTING, (6) STRUCTURAL DRAFTING, (7) MAP AND TOPOGRAPHIC DRAWING, (8) ALGEBRA, (9) TRIGONOMETRY, (10) STATICS AND STRENGTH OF MATERIALS, (11) PROPERTIES OF MATTER AND MECHANICS, (12) ANALYTICAL GEOMETRY AND CALCULUS, (13) SURVEYING, (14) ELECTRICITY AND MAGNETISM, AND (15) HEAT, LIGHT, AND SOUND. THIS DOCUMENT IS AVAILABLE FOR $4.00 FROM CURRICULUM LABORATORY, BOX NU, STATE COLLEGE, MISSISSIPPI 39762. (EM)

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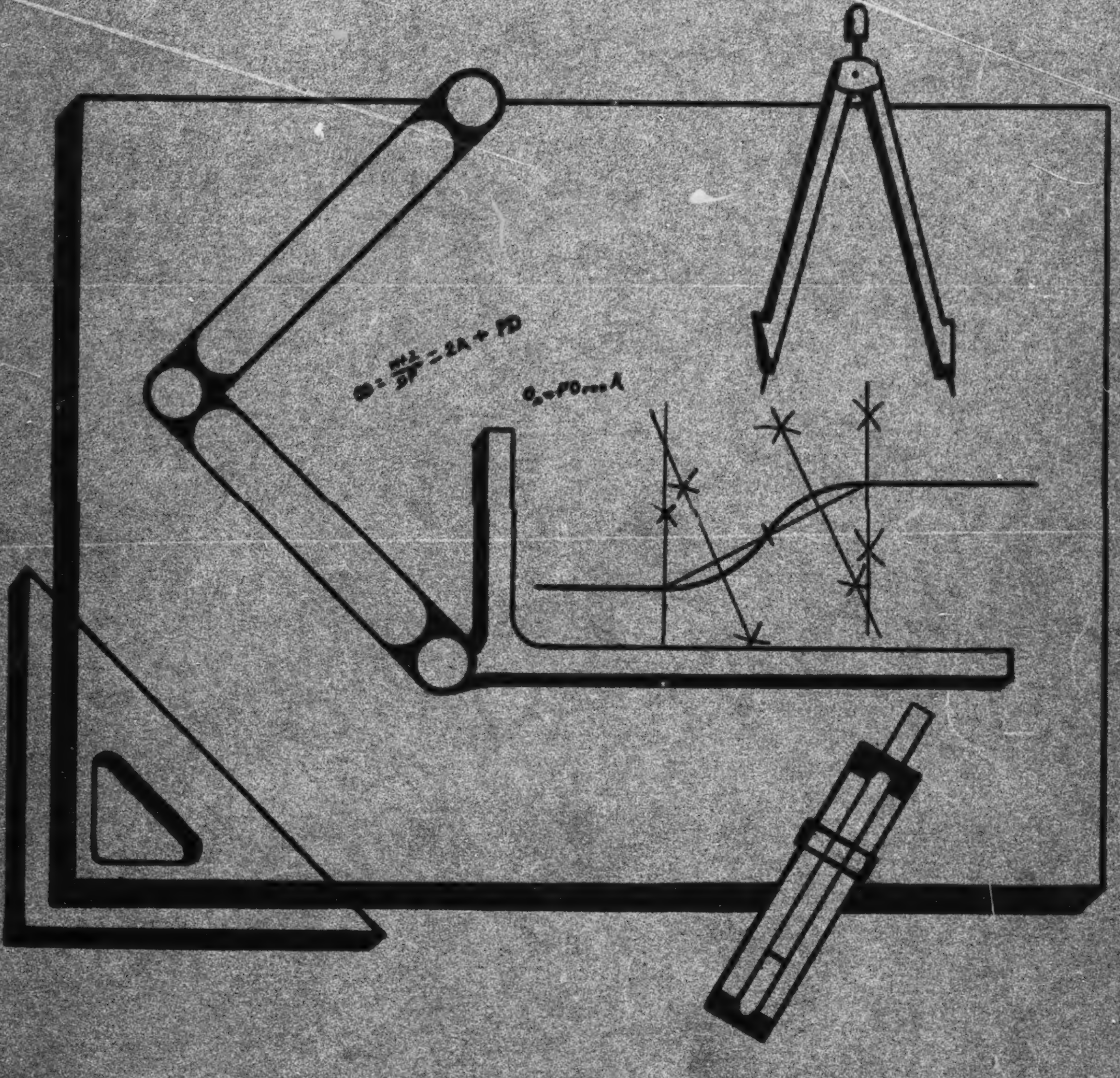
A GUIDE

For Use in Developing Training Programs

in

DRAFTING & DESIGN TECHNOLOGY



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DRAFTING & DESIGN TECHNOLOGY

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FOREWORD

DRAFTING & DESIGN TECHNOLOGY CURRICULUM

The services of instructors from Mississippi junior colleges were utilized in designing the following Drafting & Design Technology Curriculum. The initial course outlines were prepared by these instructors as a body in a work conference at Mississippi State University. At a later date, a second work conference was held involving these same men. The content of the individual courses was identified in greater detail and the curriculum was examined for inclusion of technical, supporting, and general education courses as well as proper balance of the overall curriculum. The instructors and the institutions they represent are to be commended for their contributions. The committee was composed of:

Thurman E. Alley	Pearl River Junior College
Woodfin Breland	Perkinston Junior College
Thomas D. Coats	Northwest Miss. Junior College
Jack T. Harris	Mississippi Delta Junior College
O. L. Newell	East Central Junior College
T. F. Rayburn	Hinds Junior College
M. R. Thorne	Holmes Junior College
Rodney D. Walker	Meridian Junior College

Following each of the conferences, the Curriculum Laboratory staff spent considerable time in the reorganization and editing of the units of material which resulted. This publication incorporates the thinking and contributions of all of the above listed men. It should be examined in light of this fact and used as a guide in the manner prescribed in the introductory chapter. It should not be inferred that this publication is a reflection of the practice of any given institution or is completely endorsed by any one institution, agency, or person.

The curriculum committee was ably assisted by Mr. J. G. Taylor, Jr., Associate Professor of Engineering Graphics, Mississippi State University, who acted as a consultant throughout the developmental process.

Appreciation is expressed to the State Department of Vocational Education, Trade and Technical Education Section, for its continued support, and for contributions through the efforts of Assistant State Supervisors B. C. Messer at the Initial Curriculum Conference and Ralph Caldwell at the Industrial Evaluation Conference.

The Curriculum Laboratory is grateful for the attendance and participation of Mr. W. S. Cobb, Director, Youth Affairs and Training, Mississippi Agricultural and Industrial Board, and Mr. E. P. Sylvester, Vocational-Technical Education, Junior Colleges, State Department of Education, in the developmental conferences.

Significant contributions were made by other junior college instructors. The supporting course in Statics and Strength of Materials was developed by Mr. Marcus D. Williams, Instructor in Civil Engineering Technology, Northwest Mississippi Junior College. In Map and Topographic Drawing, the photogrammetry section was developed by Mr. Art Hickman, Instructor in Drafting & Design Technology, Pearl River Junior College.

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The material in this publication was reviewed and endorsed as being appropriate and adequate for the training of Drafting & Design Technicians by the following Industrial Committee:

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Endorsement by this committee in no way obligates the individual organizations which are represented by the committee membership.

The Curriculum Materials Laboratory wishes to commend these men for their efforts in the review of this publication and the constructive manner in which suggested changes were offered. We are further indebted to the companies represented for their interest in Mississippi education as evidenced by their cooperation and participation.

TABLE OF CONTENTS

Page

Foreword iii

Authentication Committee v

Introduction to Technology 1

Drafting & Design Technology Curriculum. 13

Course Identification. 15

Proposed Curriculum. 17

TDd 113 - Fundamentals of Drafting 19

  Introduction. 21

  Course Description. 21

  Major Divisions

    I. Introduction to Drafting. 22

    II. Lettering 23

    III. Technical Sketching 24

    IV. Scales. 24

    V. Geometric Construction. 25

    VI. Multiview Projections and Dimensioning. 27

    VII. Pictorials. 29

    VIII. Sectional Views 30

    IX. Review. 31

  References. 32

TDd 223 - Descriptive Geometry 33

  Introduction. 35

Page

Course Description. 35

Major Divisions

I. Introduction to Descriptive Geometry. 36

II. Auxiliary Views 37

III. Lines 37

IV. Planes. 38

V. Line and Plane Relationship 39

VI. Curved Lines. 39

VII. Curved Surfaces 40

VIII. Warped Surfaces 40

IX. Intersections 41

X. Developments. 41

XI. Vector Geometry 42

XII. Review. 42

References. 43

TDd 235 - Machine Drafting 45

Introduction. 47

Course Description. 47

Major Divisions

I. Threads and Fasteners 48

II. Welding 49

III. Shop Processes. 50

IV. Working Drawings. 51

V. Drafting Room Practices 51

Page

VI. Reproduction of Drawings. 52

VII. Gears, Pulleys, and Drives. 52

VIII. Cams. 53

IX. Properties and Application of Materials 53

X. Review. 53

References. 54

TDd 345 - Electrical - Piping - Sheet Metal Drafting 55

Introduction. 57

Course Description. 57

Major Divisions

I. Electrical/Electronic Drafting. 58

II. Piping Drafting 58

III. Sheet Metal Drafting. 59

IV. Review. 59

References. 60

TDd 355 - Architectural Drafting 61

Introduction. 63

Course Description. 63

Major Divisions

I. Introduction to Architectural Drafting. 64

II. Standard Construction 64

III. Working Drawings. 64

IV. Perspective 65

V. Rendering 65

Page

VI. Review. 66

References. 67

TDd 465 - Structural Drafting. 69

Introduction. 71

Course Description. 71

Major Divisions

I. Introduction to Structural Drafting 72

II. Conventional Practices. 72

III. Connection Design 73

IV. Detail Drawing. 74

V. Review. 75

References. 76

TDd 474 - Map and Topographic Drawing. 77

Introduction. 79

Course Description. 79

Major Divisions

I. Introduction to Map and Topographic Drawing . . 80

II. Lettering 82

III. Traverses 82

IV. Symbols 83

V. Contours. 83

VI. Map Projection. 84

VII. Map Revisions 85

VIII. Photogrammetry. 85

Page

IX. Color Separation. 87

X. Review. 87

References. 88

Supporting Technical Courses for the Drafting and Design Technology Curriculum 89

SMa 113 - Technical Math (Algebra) 91

Course Description. 91

Major Divisions

I. Number Sets 91

II. Operations with Algebraic Expressions 91

III. Functions and Graphical Representation. 92

IV. Linear and Quadratic Functions. 92

V. Fractions 92

VI. Factoring 93

VII. Graphing. 93

VIII. Exponents 94

IX. Imaginary and Complex Numbers 94

References. 95

SMa 123 - Technical Math (Trigonometry). 97

Course Description. 97

Major Divisions

I. Radian Measure. 97

II. Trigonometric Functions 97

Page

III. Solution of Right Triangles 98

IV. Identities. 98

V. Logarithms. 98

VI. Vectors 98

VII. Oblique Triangles 99

VIII. Inverse Functions 99

IX. Complex Numbers 99

References. 100

SPr 213 - Statics and Strength of Materials. 101

Course Description. 101

Major Divisions

I. Fundamental Terms and Introduction. 101

II. Resultant and Equilibrant of Forces 102

III. Moments 103

IV. Nonconcurrent Coplanar Forces (Trusses) 103

V. Concurrent Noncoplanar Forces 103

VI. Static and Kinetic Friction 104

VII. Simple Stresses 104

VIII. Properties of Materials 104

IX. Riveted and Welded Joints and Thin Wall Cylinders 104

X. Center of Gravity, Centroids, and Moments of Inertia 105

XI. Beam Design 105

XII. Column Design 106

References. 107

Page

SSc 313 - Physics (Properties of Matter and Mechanics) 109

Course Description. 109

Major Divisions

I. Introduction. 109

II. Measurement 110

III. Atoms and Molecules. 113

IV. Properties and Phenomena of Solids. 114

V. Properties and Phenomena of Liquids 114

VI. Properties of Gases 115

VII. Vectors and Graphic Solutions 115

VIII. Force and Motion. 116

IX. Work, Energy, and Power 116

X. Analysis of Basic Machines and Friction 117

XI. Rotation, Torque, and Power Transmission. 118

References. 120

SMa 333 - Technical Math (Analytical Geometry & Calculus). . . 121

Course Description. 121

Major Divisions

I. Graphical Methods of Calculus 121

II. The Functions 121

III. Differentiation 122

IV. Differentiation of Higher Order 122

V. Integration 122

VI. Additional Trigonometric Functions in Calculus. . 123

Page

VII. Logarithmic and Exponential Functions 123

References. 124

SMa 342 - Surveying. 125

Course Description. 125

Major Divisions

I. Introduction to Surveying 125

II. Measurements of Distance. 126

III. Leveling. 126

IV. Angular Measurements and Traverses. 127

V. Computations. 128

VI. Stadia. 128

VII. Topographic Surveying 129

VIII. Land Surveying. 130

References. 131

SSc 323 - Physics (Electricity and Magnetism). 133

Course Description. 133

Major Divisions

I. Magnetism and Electricity 133

II. Basic Electrical Units and Circuits 134

III. Sources and Effects of Electric Current 136

IV. Electromagnetism. 137

V. Electromagnetic Induction 138

VI. Alternating Current 138

VII. Generators and Motors 139

Page

VIII. Production and Distribution of Electric Power . . 140

IX. Industrial Electronics. 141

References. 143

SSc 423 - Physics (Heat, Light, and Sound) 145

Course Description. 145

Major Divisions

I. Temperature and Heat. 145

II. Sound and Wave Motion 146

III. Light and Illumination. 147

IV. Principles of Optical Instruments 148

V. Atomic Energy 149

References. 150

Bibliography 151

INTRODUCTION TO TECHNOLOGY

As our nation has grown in size and complexity, it has subdivided many times, thus creating new concepts, products, and opportunities. A case in point is the growth of industry. As the research of the scientist and the engineer has separated them even more from the craftsman with his high degree of manipulative skills, the broadened middle ground has created the technician. As he has evolved, the technician has accepted the responsibility for interpretation and application of design, installation and maintenance of complex equipment, and supervisory activities.

Educators have recognized their responsibility in this area and have developed technical curricula to meet the new needs. These curricula provide certain basic education for a wide variety of entry jobs in support of engineering and scientific personnel. These supporting technicians require an understanding of engineering principles basic to the field of technology. Graduates entering the field will become responsible members of a team--the scientist who is engaged in research at the fringe between theory and knowledge, the engineer who develops and designs practical applications of theory and knowledge, and the technician who may be involved in one or more activities such as converting the design into a working model or testing and evaluating its effectiveness. With this done, the skilled craftsman converts raw materials into finished products.

The technician re-enters the picture as he supervises production or directs installation and maintenance. It is obvious then that the training of the technician is not of a limited or single skill type. Rather it should prepare him for entry into multiple employment areas within a field with basic qualifications and the ability to accept broad responsibilities.

Having accepted this training responsibility and identified objectives, educators established the technical program. Examination of successful programs reveals certain definite characteristics.

The caliber of the technical instructor is of major importance. While there is no guaranteed method of selection, there is general agreement that the level of formal training should be no less than that of technical school graduate. Broad job experience for all teachers has long been a basic requirement in occupational training. It is valid here. This means sufficient industrial experience to be familiar with applications and processes. Additional study would include philosophy, methods, and procedures of technical teaching. In given instances, it might be found advantageous to use engineers as teachers in technical programs.

A second characteristic involves physical facilities, equipment, and supplies. These items must simulate up-to-date industrial conditions. The emphasis here is on quality and variety rather than quantity.

Student admission policy and program flexibility, the third and fourth characteristics, must be considered together. Modern educational practice dictates a comprehensive guidance and testing program for the selection and/or admission of students. These potential technicians should be secondary school graduates from the upper 1/3 of the class or the equivalent, have an interest in technical work, and possess the necessary aptitudes for achievement in the program. For a variety of reasons, they may be unable to become involved in a longer, more expensive course of study. Ideally, the beginning technical student should have had two years of algebra, a year of geometry, a half year of trigonometry, and three years of science, preferably biology, chemistry, and physics. At this point, flexibility becomes important. Schools involved in technical training have found it necessary to make adjustments in their curriculum to take into account the deficiencies of those desiring such training. In some cases, it may be necessary to require students to take remedial or preparatory courses before entering the technical curriculum. Or, the level of subject matter in beginning courses must be keyed to the mathematics-science background and readiness of the students. Perhaps other ways can be found to prevent the closing of doors to likely prospects. The important consideration is the establishment of enrollment requirements which are high, yet realistic in their application. Realistic adjustment to local physical facilities, industrial requirements, staff competencies, and student capabilities should be considered carefully.

Indiscriminate or seemingly endless compromise results in a collapse of standards. This is a matter best left to the judgment of state and local officials.

The content, variety, and timing of courses in the curriculum are essential. A strong technical program has breadth and depth in fundamentals. This allows the graduate technician to qualify for and choose from multiple employment alternatives, to advance professionally with occupational experience, and to keep abreast of new developments throughout his career. The acquisition of these fundamentals will require two years brimming with activities. Specialization in a given area can be gained only by relegating fundamentals in other areas to rapid, superficial treatment. For the graduate technician, therefore, specialization and specific job information comes through experience, a company training program, or the pursuit of higher education.

The most knowledgeable technicians are those involved in mathematical analysis, construction of design apparatus, and experimental testing and verification. The requirement here is a knowledge of principles of application of physical sciences and mathematical formula. This is the distinguishing characteristic of the technician. In addition to strong general courses in physical sciences, the training of the technician goes into even greater depth in the given area of his specialty; for example, electricity and electronics for the electronics technician, properties of materials, heat, and mechanics for the mechanical technician, chemistry for the chemical technician, etc. Experience has shown that technical and supporting courses must be initiated immediately to successfully complete training in the allotted time. Inasmuch as technical and supporting courses comprise approximately two-thirds the total semester hours, they cannot be postponed until the second year or even the second semester.

Facility in the use of algebra and trigonometry is mandatory and in no instance should the training of the technician require less than mastery in their use. An understanding of applicable sections, of analytical geometry and calculus peculiar to the given technology will serve to enrich the student's background. Interpreted in semester hours, this means a minimum of 6 to 9 semester hours of mathematics which may expand to 12 semester hours in stronger programs.

The technician must interpret and relay concepts and facts orally, in writing, graphically, or mathematically. To this end he must receive training in communication skills of composition, speech, technical report preparation, and drafting.

The technician must command a degree of manipulative skill. This degree is not nearly so high as that of the craftsman and while it varies among technologies, in most instances it must be of sufficient height to assist him in the fabrication of design models. A comparison of training hours devoted to skill development in the curriculum would bear this out.

Sufficient general education must be included to assist in the development of a good citizen. The curriculum assumes an effective secondary school program of general education. Building on this foundation, 17 to 22 additional semester hours in general education are scheduled.

Effective instruction is another essential in a technical program. Routine textbook teaching is entirely inadequate. The work of the technician, characterized earlier, is of a practical and applied nature. It follows that his training should be of this nature. The key words here are "practical" and "application" and the inference is that extensive periods of time would be spent in realistic experimentation in up-to-date, well-equipped laboratories. Careful coordination between lecture topics and laboratory experiments makes best use of both periods and promotes high level learning. The most desirable situation is one in which the same instructor teaches principles in the lecture period, then supervises application in the laboratory. Experience has shown that this yields maximum motivation and learning. Failure to proceed in accordance with this practice means sacrificing time or retention in an already busy, demanding curriculum.

Studies of industrial procedures and effective technical training reveal many instances of report preparation. Information is gathered and organized, implications are drawn, and a report is submitted by the technician as the last step in his undertaking.

The selection of a text is of paramount importance to most instructors. Realistically speaking, the content and presentation of many courses are influenced to a lesser or greater degree by the texts available. Rarely does a single volume contain all the essential technical information in a given area. For these reasons most instructors find it necessary to review available materials in their field and related fields and to select additional volumes as references. In many technical programs, separate library facilities are developed apart from the main library. Here materials are gathered, catalogued, and located in class or laboratory so as to be readily accessible to instructors and students. This approach is recommended by accrediting agencies.

The preceding statements briefly describe the most widely accepted characteristics of technical education--faculty background; student enrollment; the overall curriculum including a balance between technical and non-technical courses, science, mathematics, communication skills, and general education; plants and equipment; and library facilities. The institutions of which these technical programs are a part may look forward to the time when they will submit their programs for accreditation. If this is to be the case, careful consideration should be given, in the beginning, to the above criteria which have been developed by the engineering societies.

The format of this publication is designed to lend itself to use in occupational training and in teaching by the "tell-show-do-check" method, a technique long used to good advantage. Briefly, this means present or explain the principle, show how it operates or applies, have the student put his learning to practical use, and check his newly acquired knowledge or skill. In support of this technique, two parallel columns have been developed. On the left will be an OUTLINE OF INSTRUCTION. This is the "tell" and "show" column. In it will be the theories and principles of the subject field. Some effort has been made to clearly identify the mathematics and science involved in each unit. Conventional methods such as question-answer periods, discussions, demonstrations, and audio-visual aids are to be used. In the "do" column entitled LABORATORY ACTIVITIES, the spotlight is on student activities. Experiments are designed to involve him in the practical application of principles set forth in the classroom. In most exercises, the student will set up the equipment, go through outlined procedure while taking measurements and making cogent observations, and record findings. In attempting to simulate industrial conditions, the technical program requires that information be compiled during laboratory activities. Outside the laboratory, information is organized, implications are drawn, and a report is submitted at some assigned date. No laboratory experiment is complete until a report is written and submitted. In many cases, a mathematical analysis and design will precede the experimental verification and is indicated by many references such as "mathematically compute...verify experimentally...and graphically represent..." This is the technical approach of the design technician and is one example of the scientific method employed by all.

The RECOMMENDED TEXT or texts listed following each course have been recommended by the curriculum committee as being the best available. These recommendations result from the experience of the committee membership along with additional volumes secured by the Curriculum Materials Laboratory. In the opinion of this committee, some of these books may be inadequate but, within the confines of their experience, they are the best available. Also listed are SUGGESTED REFERENCES which strengthen and broaden the instructional base. Many of these were strongly recommended by the industrial committee. Those desiring to build a library will find these books worthy of examination. It may be that one of these would serve as a text.

Formal education justifies its existence with the supposition that information imparted to students will increase their knowledge and skill and enable them to make headway in new areas whether this be the pursuit of a livelihood or advanced study. It follows that future progress is dependent to some degree on the grasp of earlier courses. With this in mind, each of the courses has a REVIEW scheduled as its last major division. At this time the instructor will review the key points and determine student command of the important knowledges and skills. Deficiencies in basics must be retaught until such time as the student, in the judgment of the instructor, has demonstrated a mastery of these essentials.

The Curriculum Materials Laboratory at Mississippi State University will serve as a means of promoting and assisting in the development and sharing of ideas and techniques in Mississippi junior colleges and secondary schools. Preparation of this publication was the first step. It is not an attempt at a "breakthrough" or "rediscovery" or "pioneering." Rather, major areas of the technology were identified and subdivided into logical, teachable units. Suitable texts and references were listed. The content was agreed upon by Mississippi junior college technical instructors and a representative industrial committee as being those minimums deemed basic and essential to a technical program.

A second step must be taken by the technical instructor. He should give this publication his best efforts after carefully studying the ideas set forth in the first part of this chapter. Examination, evaluation, and recommendation during preparation of instructional materials and while teaching from them will assist in continued program development. Lesson plans for lectures and demonstration as well as laboratory experiments should be made using this publication as a guide. The instructor will likely find more information and greater detail in some instances than he is presently using. There may be more than one laboratory experiment in the application of a principle. In other instances the development of an idea may appear too shallow or laboratory application is absent. It is at this time that the instructor can be most helpful in the following ways: (1) by suggesting which areas can be effectively covered in a shorter time, (2) by identifying areas requiring greater emphasis with additional detail and an extended time allocation, (3) by extending the instructional content to reinforce or clarify ideas,

(4) by preparing additional or alternate experiments in applying principles, (5) by listing references, texts, and instructional aids at appropriate places, and (6) by suggesting additions and deletions. Some of the above may require only marginal notes while in other instances, circumstances may call for development of completely new and more comprehensive materials. The result will be realistic evaluation of content, organization, and time allotment for each unit.

This initial effort on the part of the Curriculum Materials Laboratory is meant to encourage greater unity of offerings among the various programs. Two factors will dictate the revision of this publication--the dynamic state of industry and the development of improved teaching methods by technical instructors. The use and evaluation of this publication by people in the field will lay the necessary groundwork for future editions.

In addition, recent vocational-technical legislation contains provision for follow-up and program evaluation. The day is coming when vocational-technical education will be held accountable for its actions in training youth and adults and the millions of dollars it has spent. The Curriculum Materials Laboratory would, no doubt, be involved in developing suitable instruments and evaluative criteria at that time. This publication, representing the combined efforts of Mississippi education and industry and containing the material these groups feel is appropriate, would serve as one basis for making such a study.

DRAFTING & DESIGN TECHNOLOGY CURRICULUM

COURSE IDENTIFICATION

The coded symbols listed below are suggested as being applicable to all technical, supporting, and general education courses. Should the institutions involved adopt some mutually acceptable system, it would greatly aid in interpretation of course offerings, transcripts, and catalogs.

T - Technical Courses

- Au - Automotive
- Bc - Building and Construction
- Ch - Chemical
- Ci - Civil
- Dd - Drafting and Design
- El - Electricity
- Er - Electronics
- Me - Mechanical

S - Supporting Technical Courses

- Gr - Graphics (Art, Freehand and Mechanical Drawing, Blueprint Reading)
- Ma - Mathematics (Algebra, Trigonometry, Calculus, Analytical Geometry, Slide Rule)
- Pr - Shop Processes (Metal Processing, Materials and Methods)
- Sc - Science (Physics, Chemistry)

G - General Education Courses

Bu - Business (Business Principles, Accounting, Bookkeeping)

En - English (Composition, Technical Writing, Business Correspondence)

Mg - Management (Industrial Relations, Plant Layout and Materials Handling, Time and Motion Study)

Or - Orientation

Ps - Psychology (General, Industrial, Social)

Pe - Physical Education (Health, Hygiene)

Ss - Social Studies (History, Sociology, Government)

The preceding letter coding of courses is further developed here by the addition of three place numbering. The first number or first place designates the semester the given course is normally offered. The second place designates the number of the course in sequence. The third place designates the semester hour(s) credit the given course carries.

Having set the stage, the following is a suggested curriculum containing identification by letter and number and a balance of courses in technology related or supporting subjects, and general education.

PROPOSED CURRICULUM
DRAFTING & DESIGN TECHNOLOGY

First Semester

Course	Title	Hours Credit
TDd 113	Fundamentals of Drafting	3
SMa 113	Technical Math I (Algebra)	3
GSs 113	Social Science (History)	3
GEn 113	English (Composition)	3
GMg 113	Industrial Organizations & Institutions	3
GEn 122	English (Speech)	2
		17

Second Semester

Course	Title	Hours Credit
TDd 223	Descriptive Geometry	3
TDd 235	Machine Drafting	5
SMa 223	Technical Math II (Trigonometry)	3
SPr 213	Strength of Materials	3
SSc 213	Physics I (Properties of Matter & Mechanics)	3
GEn 232	English (Technical Writing)	2
		19

Third Semester

Course	Title	Hours Credit
TDd 345	Electrical, Piping, Sheet Metal Drafting	5
TDd 355	Architectural Drafting	5
SMa 333	Technical Math II (Analytical Geo. & Cal.)	3
SMa 342	Surveying	2
SSc 323	Physics II (Electricity & Magnetism)	3
		18

Fourth Semester

Course	Title	Hours Credit
TDd 465	Structural Drafting	5
TDd 474	Map and Topographical Drafting	4
SSc 433	Physics III (Heat, Light, & Sound)	3
GSs 423	Social Science (Economics)	3
GPs 413	Industrial Psychology	3
		18

TDd 113

FUNDAMENTALS OF DRAFTING

3 Semester Hours

INTRODUCTION

Success in this course requires mathematical ability in the addition, subtraction, multiplication, and division of fractions, whole numbers, complex numbers, and decimals as well as conversion from one form to another. A high school course in plane geometry, or its equivalent, is a required prerequisite.

Communication with industry indicates that the fundamental in which beginning draftsmen are most likely to be deficient is lettering skill. Lettering practice begins early in this course using upper-case Gothic only. Assignments made are completed outside the class room or laboratory.

It is generally conceded that most efficient teaching methods require the combining of dimensioning and multiview projection in lecture and laboratory sessions. This is to say that while there is no strict adherence to the outline, each of the subdivisions is covered as needed.

TDd 113. __Fundamentals of Drafting__. One lecture. Four hours laboratory. (3 semester hours credit). A basic course covering areas common to all drafting with special emphasis on proper technique and early habit formation.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Introduction to Drafting	2	2
II.	Lettering	2	2
III.	Technical Sketching	2	8
IV.	Scales	1	2
V.	Geometric Construction	3	12
VI.	Multiview Projection and Dimensioning	4	26
VII.	Pictorials	1	6
VIII.	Sectional Views	3	14
IX.	Review		
		Total Class Hours __18__	Total Laboratory Hours __72__

Total Suggested Clock Hours __90__

I. INTRODUCTION TO DRAFTING

A. OUTLINE OF INSTRUCTION Class Hours 2	B. LABORATORY ACTIVITIES Laboratory Hours 2
1. History a. Biblical reference to Solomon's Temple b. Chaldean Fortress c. Roman architectural drafting d. Italian projection e. Early descriptive geometry f. Modern technical drawing	
2. Types of drawings a. Artistic b. Technical	
3. Equipment and supplies a. Standard drafting b. Drafting media c. Reproduction equipment d. Reproduction media	Examination of drafting equipment including: drafting machines, instruments, triangles, irregular curves, scales, templates, pencils, pens, ink, paper types, and cleaning equipment.
4. Alphabet of lines a. Widths of lines b. Meaning of lines c. Proper method of drawing	Develop line technique including coding and width.
5. Sheet layout a. Typical sheet sizes b. Borders and title blocks	Layout of various borders and title blocks. Calculate placement of these for various paper sizes.

c. Arrangement of lettering

II. LETTERING

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Lettering
    - a. Gothic
    - b. Roman
    - c. Italic
    - d. Text
2. Composition
    - a. Uniformity
    - b. Stability
    - c. Condensed
    - d. Extended
3. Guide lines
    - a. Horizontal
    - b. Vertical
    - c. Inclined
4. Types
    - a. Lightface
    - b. Boldface
    - c. Vertical
        - (1) Upper case
        - (2) Lower case
    - d. Inclined
        - (1) Upper case
        - (2) Lower case
5. Lettering instruments
    - a. Ames lettering instrument

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Develop border system, title strip, and guide lines. These layouts are to be used in the exercises to be assigned in lettering practice.

Exercises in lettering techniques for: a. upper case vertical, b. upper case inclined, c. lower case vertical, d. lower case inclined.

Use lettering instruments for drawing guide lines on all lettering practice.

- b. Braddock and Rowe
- c. Leroy lettering device
- d. Wrico lettering device
- e. Grid Back Up Sheets

Leroy and other lettering devices using ink to be used later in the course where inked drawings are assigned.

III. TECHNICAL SKETCHING

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Lines
    - a. Straight lines
    - b. Circles and arcs
    - c. Ellipses
2. Multiview
    - a. Proportion
    - b. Regular views
    - c. Choice of views
    - d. Alginment of views
    - e. Precedence of lines
3. Pictorials
    - a. Isometric sketching
    - b. Oblique sketching
    - c. Perspective sketching

B. LABORATORY ACTIVITIES
Laboratory Hours 8

Sketching of straight lines and arcs; sketching simple geometric figures and solids.

Sketch simple solids to develop sense of proportion, ability to select and align views, and recognize precedent of lines. Sketch four plates involving objects having arcs, angles, holes, slots, grooves, etc.

Sketch one figure representative of each of the three types listed in lecture

IV. SCALES

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Engineers
2. Architects

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Application in the use of all scales in the measurement of and drawing of line

3. Metric

segments. Drawings hereafter will include those other than FULL SIZE.

V. GEOMETRIC CONSTRUCTION

A. OUTLINE OF INSTRUCTION

Class Hours 3

1. Bisecting arcs, lines, and angles
   - a. Compass and triangle
   - b. Triangle and T-square
2. Parallel and perpendicular lines
   - a. Compass and straight edge
   - b. T-square and triangle
   - c. Drafting machine
3. Dividing a line into equal parts
   - a. Conventional method
   - b. Method preferred by draftsmen
4. Constructing regular polygons
   - a. Conventional methods
   - b. Methods preferred by draftsmen
5. Tangents
   - a. Circle tangent to a line at a given point
   - b. Tangent to a circle through a point
   - c. Tangents to two circles

B. LABORATORY ACTIVITIES

Laboratory Hours 12

Use of equipment in geometric construction techniques as described in lecture outline. One or more problems involving the proper procedure in the execution of methods listed in topics 1 through 5.

d. Line through a given point and tangent to an arc	
e. Tangent arc to two lines at right angles	
f. Tangent arc to two lines at acute or obtuse angles	
g. Tangent arc to an arc and a straight line	
h. An arc tangent to two arcs	
i. An arc tangent to two and enclosing one or both	
j. A series of tangent arcs conforming to a curve	
k. Tangent arcs forming an ogee curve	
l. A curve tangent to three intersecting lines	
6. Constructing ellipses a. Axes and Foci method b. Trammel method c. Concentric circle method d. Ellipse on conjugate diameters e. Parallelogram ellipse f. Approximate ellipse	Construct six ellipses: one by each method listed under topic 6. Each student must make his own Trammel for use in constructing the ellipse by the Trammel method.
7. Parabola a. Given focus and directrix b. Given rise and span c. Given rectangle or parallelogram d. To join two points by a parabolic curve	Construct parabolas using at least two of the four methods listed by which a parabola may be constructed.

8. Hyperbola
9. Involute
10. Spiral of Archimedes
11. Cycloid
12. Epicycloid
13. Hypocycloid
14. Helix

Construct one drawing of each geometric construction listed inder topics 8 through 14.

Outside assignments may be made on the drawings listed above.

VI. MULTIVIEW PROJECTIONS AND DIMENSIONING

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Relationship of views to folding line
    a. Relationship of views to folding line
    b. Conventional placement of views
    c. Alternate positions of views
    d. Partial view location
    e. Removed views location
2. Angles of projection
    a. First angle projection
    b. Third angle projection
3. Lines
    a. Visible lines
    b. Invisible lines
    c. Center lines

B. LABORATORY ACTIVITIES
Laboratory Hours 26

Use of visual aids

Practice problems include projections that incorporate procedures and practices of properly indicating all topics discussed under OUTLINE OF INSTRUCTION. These should include dimensioning practice also.

- d. Lines produced by the intersection of two surfaces
- e. Omission of line at the intersection of two surfaces

4. Surfaces

   - a. Normal surfaces
   - b. Inclined surfaces
   - c. Oblique surfaces
   - d. Curved surfaces

5. Curves

   - a. Fillets
   - b. Rounds
   - c. Runouts

6. Placement and methods of dimensioning

   - a. Offviews
   - b. On views
   - c. Alignment system
   - d. Undirectional system

Dimensioning practice involving the correct procedures discussed in the lecture or lectures on dimensioning are to be executed on all drawings assigned under the topic "Multiview Projection". Specific plate assignments that follow are not "additions to" but a "part of" the drawings mentioned above.

7. Line codes

8. Special dimensions

   - a. Mating dimensions
   - b. Machine pattern and forging dimensions
   - c. Notes in dimensioning

9. Preference in dimensioning

   - a. Function dimensions
   - b. Shop processes

10. Terms and definitions used

    a. Dimension line
    b. Extension line
    c. Arrowheads
    d. Leaders
    e. Notes
    f. Finish marks
    g. Dimension figures

11. Classes of fit

    a. Running and sliding fits
    b. Locations fits
    c. Force fits
    d. Tolerances

One or more plates that involve the proper execution of the designation of the various fits listed under "Classes of fit".

One plate to show the proper method of dimensioning tolerances.

12. Surface quality control

    a. Roughness
    b. Waviness
    c. Lay

Indicate properly the surface qualities listed in the lecture column on at least one drawing.

13. Machine finishes

    a. Ream
    b. Grind
    c. Hone
    d. Lap, polish, super-finish

Use the correct method to indicate machine finishes: ream, grind, hone, lap, and polish on one or more drawings.

VII. PICTORIALS

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Axonometric

    a. Isometric
    b. Dimetric
    c. Trimetric

B. LABORATORY ACTIVITIES
Laboratory Hours 6

Use of instruments and equipment in pictorial representation assignments. Dimension all plates.

2. Oblique
    - a. Cavalier
    - b. Cabinet

VIII. SECTIONAL VIEWS

A. OUTLINE OF INSTRUCTION
Class Hours 3

1. Types
    - a. Full section
    - b. Half section
    - c. Broken-out section
    - d. Revolved section
    - e. Removed section
    - f. Phantom section
    - g. Offset section
    - h. Aligned section
    - i. Partial section
2. Section lining
    - a. Symbols
    - b. Spacing
    - c. Angle and direction
3. Conventional practice
    - a. Placement of Views
    - b. Treatment of spokes
    - c. Treatment of ribs
    - d. Thin sections
    - e. Treatment of shafts, fasteners, ball bearings, and other parts

B. LABORATORY ACTIVITIES
Laboratory Hours 14

Section and dimension selected problems to illustrate various types of sectioning and conventional practice. At least one problem involving each type of section is recommended.

Section lining practices are to be used on all problems that are fully or partially sectioned.

Execute properly the conventional practices listed under item 3.

IX. REVIEW

A. OUTLINE OF INSTRUCTION
Class Hours __

1. Review key areas
2. Evaluate student's command of material
3. Give additional emphasis to weak areas

B. LABORATORY ACTIVITIES
Laboratory Hours __

Assign additional laboratory applications for reinforcment.

RECOMMENDED TEXT:

Giesecke, Frederick E., Alva Mitchell, and Henry Cecil Spencer. Technical Drawing. 4th ed. New York: The Macmillian Company, 1958.

Grant, Hiram E. Practical Descriptive Geometry. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1963.

Zozzora, Frank. Engineering Drawing. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1958.

SUGGESTED REFERENCES:

French, Thomas E., and Charles J. Vierck. Engineering Design. New York: Holt, Rinehart, Winston, 1963.

Giachino, J. W., and Henry J. Beukema. Drafting and Graphics. Chicago, Illinois: American Technical Society, 1961.

Luzadder, Warren J. Fundamentals of Engineering Drawing. 4th ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1959.

Pare, Eugene G., and others. Introduction to Engineering Design. New York: Holt, Rinehart, Winston, 1963.

TDd 223

DESCRIPTIVE GEOMETRY

3 Semester Hours

INTRODUCTION

An introductory course in descriptive geometry in which a short history, the justification for placement in a drafting technology curriculum, and a brief review of orthographic projection preceeds subject matter. The standard items of drafting equipment and supplies are used.

In each major division, the concept is presented first in its academic form with a problem in application. This is immediately followed with a practical application before preceding to the next major division. The emphasis on line quality and lettering technique is continued.

TDd 223. Descriptive Geometry. One lecture. Four hours laboratory. (3 semester hours credit). Theory and problems designed to develop the ability to visualize points, lines, and surfaces in space, to relate them to each other, and to apply these relationships in the solution of drafting problems.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Introduction to Descriptive Geometry	2	4
II.	Auxiliary Views	2	8
III.	Lines	2	6
IV.	Planes	2	6
V.	Line and Plane Relationship	2	6
VI.	Curved Lines	1	6
VII.	Curved Surfaces	1	6
VIII.	Warped Surfaces	1	4
IX.	Intersections	2	10
X.	Developments	2	10
XI.	Vector Geometry	1	6
XII.	Review	—	—
		Total Class Hours 18	Total Laboratory Hours 72

Total Suggested Clock Hours 90

I. INTRODUCTION TO DESCRIPTIVE GEOMETRY

A. OUTLINE OF INSTRUCTION Class Hours 2	B. LABORATORY ACTIVITIES Laboratory Hours 4
1. History a. Origination b. Early use of descriptive geometry	
2. Place in drafting curriculum a. Graphical means of working drawing problems b. Other solutions to working drawing problems	
3. Review of orthographic projections a. The projection box b. The principal planes of projection c. Arrangement of views	Use of reference planes in orthographic projection with special emphasis on line and plane position.
4. Reference plane and its relationship to orthographic projection a. Horizontal b. Frontal c. Profile	
5. Visualization of lines a. Seven typical positions of a plane b. Seven typical positions of a line.	Identification of the various reference lines and planes taking into consideration their position in space.

II. AUXILIARY VIEWS

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Definition and uses
2. Reference planes
    a. Horizontal reference plane
    b. Profile reference plane
    c. Frontal reference plane
3. Types of auxiliary views
    a. Auxiliary elevation
    b. Right auxiliary views
    c. Left auxiliary views
    d. Front auxiliary views
    e. Rear auxiliary views

B. LABORATORY ACTIVITIES
Laboratory Hours 8

Make use of all three reference planes in the development of auxiliary views. Stress the importance of each reference plane and its proper position. Label each reference plane.

Use of auxiliary views to represent true size and shape of inclined and oblique planes.

III. Lines

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Normal view
    a. Definition of normal view
    b. Uses of normal view
    c. How to obtain normal view
2. End view
    a. Definition of end view
    b. Uses of end view
    c. How to obtain end view

B. LABORATORY ACTIVITIES
Laboratory Hours 6

Label the reference planes used in developing normal views of lines where the lines show as a point in one view.

Assign problems involving the normal and end view of lines. Determine parallel and perpendicular line relationship. Show all construction work and the use of reference planes.

3. Parallel lines
    - a. Parallel line appearance
    - b. Direction of sight of parallel lines

4. Perpendicular lines
    - a. Rules for determining
    - b. Perpendicular line appearance

5. Skew line
    - a. Definition of skew line
    - b. Uses of skew line
    - c. How to construct a skew line

IV. PLANES

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Edge view of planes
    - a. Use of edge views
    - b. Method of obtaining edge view of planes

2. Normal view of planes
    - a. Definition of normal view
    - b. Use of normal view
    - c. Obtaining a normal view

3. Parallel planes
    - a. Uses of parallel planes
    - b. How to construct parallel planes

B. LABORATORY ACTIVITIES
Laboratory Hours 6

Show the edge view of a plane formed by two intersecting lines. Show the slope of the plane.

Assign problems involving the edge view and the normal view of planes. Show all construction work.

4. Perpendicular planes
    a. Uses of perpendicular planes
    b. Method of constructing

Determine the parallel and perpendicular line relationship.

V. LINE AND PLANE RELATIONSHIP

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Angle between line and plane
    a. Complimentary angle method
    b. Direct method
    c. Revolution method
2. Angle between planes
    a. Revolution method
    b. Edge view of both planes

B. LABORATORY ACTIVITIES
Laboratory Hours 6

Stress the importance of each view while using the revolution method in determining the angle between two planes.

VI. CURVED LINES

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Circles
    a. In oblique plane
    b. Circle in perspective
    c. To find the shadow of a circle

B. LABORATORY ACTIVITIES
Laboratory Hours 6

Assign problems in the various conic sections.

2. Ellipse

a. Definition
b. Construction

3. Parabola

a. Definition
b. Construction

4. Hyperbola

a. Definition
b. Construction

5. Cycloidal curves

Assign problems in the various cycloidal curves.

6. Plane curves in space

VII. CURVED SURFACES

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Single curve

a. Definition

b. Listing of single curved

c. How to develop

2. Double curved

a. Definition
b. Listing of several
c. How to develop

B. LABORATORY ACTIVITIES
Laboratory Hours 6

Draw and develop objects with single and double curved surfaces:

Example: a. convalute
b. cylinder
c. parabola
d. oblate ellipsoid

VIII. WARPED SURFACES

A. OUTLINE OF INSTRUCTION
Class Hours 1

B. LABORATORY ACTIVITIES
Laboratory Hours 4

1. Single ruled
    a. Kinds of single warped surfaces
    b. Practical uses
    c. Method of developing
2. Double ruled
    a. Kinds of double ruled warped surfaces
    b. Uses of double ruled warped surfaces
    c. Methods of developing

Assign problems on single and double ruled warped surfaces.

Example: a. warped cone
b. warped surface transition

IX. INTERSECTIONS

A. OUTLINE OF INSTRUCTION

Class Hours 2

1. Line and plane
2. Plane and plane
3. Solid and plane
4. Solid and solid

B. LABORATORY ACTIVITIES

Laboratory Hours 10

Locate, show point of intersection, and show visibility for the following:
a. Cutting plane
b. Cutting spear
c. Parallel cylinder
d. Edge view
e. Piercing point

X. DEVELOPMENTS

A. OUTLINE OF INSTRUCTION

Class Hours 2

1. Prisms
2. Pyramids
3. Cones

B. LABORATORY ACTIVITIES

Laboratory Hours 10

Assign problems on each of the developments of the geometric solids in the lecture column. Stretchout view should show inside of object. Make right section where needed, show total length, show bend lines

4. Cylinders

5. Transitional pieces

when necessary, lay out in proper sequence.

Draw and develop transitional pieces.

XI. VECTOR GEOMETRY

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Force system

2. Composition of forces

3. Resolution of forces

B. LABORATORY ACTIVITIES
Laboratory Hours 6

Assign space for vector diagrams of force systems for composition of forces and resolution of forces.

XII. REVIEW

A. OUTLINE OF INSTRUCTION
Class Hours —

1. Review key areas

2. Evaluate student's command of material

3. Give additional emphasis to weak areas

B. LABORATORY ACTIVITIES
Laboratory Hours —

Assign additional laboratory applications for reinforcement.

RECOMMENDED TEXT:

Grant, Hiram E. *Practical Descriptive Geometry*. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1963.

OR

Wellman, B. Leighton. *Technical Descriptive Geometry*. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1957.

Warner, Frank M., and Matthew McNeary. *Applied Descriptive Geometry Problem Book*. 5th ed. New York: McGraw-Hill Book Company, Inc., 1959.

SUGGESTED REFERENCES:

Hawk, Minor C. *Outline of Theory and Problems of Descriptive Geometry*. New York: Schaum Publishing Company, 1962.

Pare, Eugene G., and others. *Descriptive Geometry*. 2nd ed. New York: The Macmillian Company, 1962.

Rowe, Charles Elmer, and James Dorr McFarland. *Engineering Descriptive Geometry*. 3rd ed. Princeton, New Jersey: D. Van Nostrand Company, Inc., 1961.

Street, William E. *Technical Descriptive Geometry*. Princeton, New Jersey: D. Van Nostrand Company, Inc., 1948.

TDd 235

MACHINE DRAFTING

5 Semester Hours

INTRODUCTION

Machine Drafting, like Introduction to Drafting, contains much material which is artifically outlined into major divisions and subdivisions for purposes of detailed identification. It is not recommended that the outline be strictly adhered to in a step-by-step fashion. The content of major divisions 3, 4, and 5 is interwoven and the instructor presents segments of each as the student progresses. For this reason, the laboratory allocation for these three are combined. Lettering technique is emphasized by assigning practice outside the drawing room and evaluating lettering quality on each drawing.

TDd 235. Machine Drafting. Two lectures. Six hours laboratory. (5 semester hours credit). Emphasizes methods, techniques and procedures in presenting screws, bolts, rivets, springs, thread types, symbols for welding, materials, finish and heat treatment notation, working order preparation, routing, and other drafting room procedures.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Threads and Fasteners	3	9
II.	Welding	4	10
III.	Shop Processes	6	10
IV.	Working Drawings	9	55
V.	Drafting Room Practices	4	
VI.	Reproduction of Drawings	2	
VII.	Gears, Pulleys, and Drives	3	9
VIII.	Cams	2	6
IX.	Properties and Applications of Materials	3	9
X.	Review		

Total Class Hours 36

Total Laboratory Hours 108

Total Suggested Clock Hours 144

I. THREADS AND FASTENERS

A. OUTLINE OF INSTRUCTION Class Hours 3	B. LABORATORY ACTIVITIES Laboratory Hours 9
1. Screw threads a. History b. Thread terms c. Standardization of threads d. Thread forms e. Single and multiple threads f. American national thread series g. Unified screw threads h. Thread classes i. Thread representation j. Classes of fit and thread notes	Problem assignments involving representation of the various forms of screw threads, classes of fit, and notes.
2. Threaded fasteners a. Through bolts b. Stud bolts c. Wood screws d. Cap screws e. Set screws f. Machine screws g. Special screws and bolts h. Fastener specifications i. Nuts and bolts	Representation of fasteners listed in instructional column using appropriate tables and formulas.
3. Keys a. Types b. Shapes	Representation of the types and shapes covered in instruction column following standard tables as to size, fits and dimensions.
4. Pins a. Types b. Shapes	Representation of the types and shapes covered in instruction column following standard tables as to size, fits and dimensions.
5. Springs	Assign problem involving extension, compression and

- a. Classification
- b. Terms
- c. Types

6. Rivets
   - a. Kinds
   - b. Types of joints
   - c. Selection of rivets
   - d. Representation

torsion springs, using tables and dimensions.

No problem assignment at lecture time.

II. WELDING

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Welding processes
   - a. Oxacetylene
   - b. Metallic arc
   - c. Carbon arc
   - d. Stud welding
   - e. Atomic hydrogen
   - f. Inert gas welding
   - g. Submerged arc welding
   - h. Thermit welding
   - i. Spot welding
   - j. Pulsation welding
   - k. Projection welding
   - l. Seam welding
   - m. Flash welding
   - n. Forge welding
2. Bonding Processes
   - a. Brazing
   - b. Soft soldering
3. Types of Joints
   - a. Butt joint
   - b. Corner joint
   - c. Tee joint
   - d. Lap joint
   - e. Edge joint
4. Types of welds
   - a. Fillet

B. LABORATORY ACTIVITIES
Laboratory Hours 10

Laboratory visitation.

b. Plug or slot
c. Groove

5. Welding symbols

   a. General explanation of welding symbols
   b. Fillet weld symbols
   c. Plug weld symbols
   d. Slot weld symbols
   e. Arc spot weld symbols
   f. Arc seam weld symbols
   g. Groove weld symbols
   h. Flange weld symbols
   i. Resistance-spot weld symbols
   j. Resistance-seam weld symbols
   k. Projection weld symbols
   l. Flash or upset weld symbols

Representation of joint types, weld types, and welding methods using standard symbols.

III. SHOP PROCESSES

A. OUTLINE OF INSTRUCTION
Class Hours 6

1. Forging

   a. Drop-forging
   b. Press forging
   c. Rolling
   d. Upsetting
   e. Extruding

2. Casting

   a. Methods
   b. Designing castings

3. Machining

   a. Methods
   b. Types
   c. Finishes

4. Plating & Coatings

B. LABORATORY ACTIVITIES
Laboratory Hours 10

Laboratory visitation

IV. WORKING DRAWINGS

A. OUTLINE OF INSTRUCTION
Class Hours 9

1. Detail drawing
    - a. Layout and arrangement
    - b. Types
        - (1) Pattern shop detail
        - (2) Forging details
        - (3) Machine details
        - (4) Welding details
        - (5) Stamping drawing
2. Assembly drawings
    - a. General assembly drawing
        - (1) Views
        - (2) Dimensions
        - (3) Hidden lines
        - (4) Identification of part
    - b. Detail assembly
    - c. Diagram assembly
    - d. Assembly sectioning
    - e. Working-drawing assembly
    - f. Installation assemblies
    - g. Check assemblies

B. LABORATORY ACTIVITIES
Laboratory Hours __

Detail drawings for various processes and uses.

Use of previously made detail drawings in making assembly drawings of major types.

Design a simple machine, including in this machine permanent and removables, fasteners, various machine processes and following standard drafting room practices

Assignment involving various drafting room practices (working orders, change orders, revisions, etc.)

V. DRAFTING ROOM PRACTICES

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Department organizations
2. Duties and responsibilities of the draftsman
3. Routing of drawing
4. Work orders, change orders, progress charts, individual work log
5. Checking drawings
6. Title blocks
7. Drawing numbering system

B. LABORATORY ACTIVITIES
Laboratory Hours __

8. Revisions of drawings
9. Inactivation of drawings
10. Roll end marking
11. Zoning of drawing
12. Folding & filing prints
13. Microfilming drawings
14. Bill of materials
15. Specifications
16. Blue print control

VI. REPRODUCTION OF DRAWINGS

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Graphic reproduction processes
    - a. Iron process
    - b. Diazo process
    - c. Silver process
    - d. Electrostatic process
    - e. Heat process

B. LABORATORY ACTIVITIES
Laboratory Hours __

Reproduction of individual detail and assembly drawings by available processes.

VII. GEARS, PULLEYS, AND DRIVES

A. OUTLINE OF INSTRUCTION
Class Hours 3

1. Types of gears
    - a. Spur
    - b. Rack
    - c. Internal
    - d. Pinion
    - e. Bevel
    - f. Miter
    - g. Helical
    - h. Worms and worm gears
    - i. Roller chain and sprockets
2. Standard spur gear terms
3. Spur gear tooth profile
4. Detail drawings of gears
5. Rack and pinion
6. Bevel and miter gears
7. Formulas

B. LABORATORY ACTIVITIES
Laboratory Hours 9

Representation of various gear types and parts using standard formulas and tables.

8. Splines
9. Serrations
10. Bearing
    a. Types
    b. Selection
    c. Representing bearing on drawing

VIII. CAMS

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Followers
    Types
2. Cam motion
    Kinds
3. Motion diagrams
    Kinds
4. Profiles
    Types

B. LABORATORY ACTIVITIES
Laboratory Hours 6

Problems involving selected cam representations and motion diagrams using standard formulas and tables.

IX. PROPERTIES AND APPLICATION OF MATERIALS

A. OUTLINE OF INSTRUCTION
Class Hours 3

1. Metals (ferrous and non-ferrous)
    a. Sources
    b. Processes
    c. Applications
2. Others
    a. Plastics
    b. Woods
    c. Miscellaneous

B. LABORATORY ACTIVITIES
Laboratory Hours 9

Experimentation involving properties such as tensile strength, resistance to corrosion and heat, alloying, bonding, etc.

Experimentation involving applications and properties.

X. REVIEW

A. OUTLINE OF INSTRUCTION
Class Hours __

1. Review key areas
2. Evaluate student's command of material
3. Give additional emphasis to weak areas

B. LABORATORY ACTIVITIES
Laboratory Hours __

Assign additional laboratory applications for reinforcement.

RECOMMENDED TEXT:

Giesecke, Frederick E., Alva Mitchell, and Henry Cecil Spencer. Technical Drawing. 4th ed. New York: The Macmillian Company, 1958.

Zozzora, Frank. Engineering Drawing. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1958.

SUGGESTED REFERENCES:

French, Thomas E., and Charles J. Vierck. Engineering Design. New York: Holt, Rinehart, and Winston, 1963.

Giachino, J. W., and Henry J. Beukema. Drafting and Graphics. Chicago, Illinois: American Technical Society, 1961.

Le Grand, Rupert. The New American Machinist's Handbook. New York: McGraw-Hill Book Company, Inc., 1955.

Luzadder, Warren J. Fundamentals of Engineering Drawing. 4th ed. Englewood Cliffs, New Jersey: Prentice-Hall Publishers, Inc., 1959.

Pare, Eugene E., and others. Introduction to Engineering Design. New York: Holt, Rinehart, and Winston, 1963.

TDd 345

ELECTRICAL - PIPING - SHEET METAL DRAFTING

5 Semester Hours

INTRODUCTION

Lecture sessions familiarize students with appropriate codes, regulations, and rulings. Laboratory activities involve representation of objects and features with proper coding application and location. The emphasis on lettering is continued through outside assignments and the evaluation of lettering quality on each drawing.

TDd 345. Electrical - Piping - Sheet Metal Drafting. Two lectures. Six hours laboratory. (5 semester hours credit). An advanced course in drafting in which technique and knowledge are employed in the planning of mechanical and electrical objects. Efficient use of all common types of applicable handbooks, code books and other standard references are an integral part of this phase of drafting.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Electrical/Electronics Drafting	24	82
II.	Piping Drafting	4	6
III.	Sheet Metal Drafting	8	20
IV.	Review	—	—

Total Class Hours 36

Total Laboratory Hours 108

Total Suggested Clock Hours 144

I. ELECTRICAL/ELECTRONIC DRAFTING

A. OUTLINE OF INSTRUCTION Class Hours 24	B. LABORATORY ACTIVITIES Laboratory Hours 82
1. NEMA standards Use and purpose	NEC and NEMA standards in applied problems.
2. Circuit diagrams a. Types b. Relay c. Power switchboard d. Checking circuits	
3. Other standards and specifications a. MIL-standards b. AN-standards	
4. Printed circuitry Production methods	Make printed circuit board drawing by tape method, ink method, and strip method. Make board assembly drawings
5. Electrical/Electronic packaging Standards (1) Cutouts (2) Drawers (3) Slides (4) Racks (5) Others	Develop packaging drawings for racks, drawers, blanks, etc.

II. PIPING DRAFTING

A. OUTLINE OF INSTRUCTION Class Hours 4	B. LABORATORY ACTIVITIES Laboratory Hours 6
1. Pipe fittings a. Screw b. Buttwelded	Make one isometric involving fittings from lecture column.

   c. Flanged
   d. Sweated

2. Standards and symbols

Make one schematic involving symbols in piping.

III. SHEET METAL DRAFTING

A. OUTLINE OF INSTRUCTION
Class Hours 8

1. Flat Pattern
   - a. Set back
   - b. "X" distance
   - c. Bend-Radii
   - d. Edge-margin
   - e. Minimum flange
   - f. Hydro-press
   - g. Brade-forming
   - h. Yoggles
   - i. Sheet-metal-forming tables

2. Metal templates

   Use and production

3. Stampings
   - a. Use and production
   - b. Tooling
   - c. Standard "of the shelf" tooling

B. LABORATORY ACTIVITIES
Laboratory Hours 20

Assign specific drawing involving the flat pattern types listed in the lecture column.

Develop details and assemblies for stamping and the necessary tooling.

IV. REVIEW

A. OUTLINE OF INSTRUCTION
Class Hours __

1. Review key areas

2. Evaluate student's command of material

3. Give additional emphasis to weak areas

B. LABORATORY ACTIVITIES
Laboratory Hours __

Assign additional laboratory applications for reinforcement

RECOMMENDED TEXT:

Bishop, Calvin C. *Electrical Drafting and Design*. 3rd ed. New York: McGraw-Hill Book Company, Inc., 1952.

OR

Giesecke, Frederick E., Alva Mitchell, and Henry Cecil Spencer. *Technical Drawing*. 4th ed. New York: The Macmillian Company, 1958.

SUGGESTED REFERENCES:

Betterley, Melvin L. *Sheet Metal Drafting*. New York: McGraw-Hill Book Company, Inc., 1961.

Crocker, Sabin. *Piping Handbook*. 4th ed. New York: McGraw-Hill Book Company, Inc., 1945.

D'Arcangelo, Guest. *Blueprint Reading, Plumbing Trades*. Albany, New York: Delmar Publishers, Inc., 1963.

Graham, Kennard C. *National Electrical Code Blueprint Reading*. New York: American Institute of Technology, 1961.

Littleton, Charles T. *Industrial Piping*. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1962.

Mullin, Ray C. *Electrical Trades Blueprint Reading.* Albany, New York: Delmar Publishers, Inc., 1963.

Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards*. 5th ed. New York: John Wiley & Sons, Inc., 1956.

Thompson, Charles H. *Fundamentals of Pipe Drafting.* New York: John Wiley & Sons, Inc., 1958.

TDd 355

ARCHITECTURAL DRAFTING

5 Semester Hours

INTRODUCTION

This course is to be built around the work normally required of an architectual draftsman in a practicing architects office. The student will be introduced to the methods employed by architects in developing working drawings. Conventional wood framing and masonry bearing wall construction will be investigated as well as normal finish materials. Some time will be given to familiarize the students with architectual terms, materials, and conventional indications of materials. The requirements for summer and winter air conditioning, ventilation, plumbing, and electrical work will be discussed. Field trips will be used to illustrate class and laboratory work. Prints of actual working drawings of buildings recently constructed in the area will be used as part of the instruction material. Lettering practice is expanded to include architectural forms.

TDd 355. Architectual Drafting. Two lectures. Six hours laboratory (5 semester hours credit). Presentation and application of architectural drafting room standards.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Introduction to Architectural Drafting	2	2
II.	Standard Construction	16	10
III.	Working Drawings	13	90
IV.	Perspective	4	4
V.	Rendering	1	2
VI.	Review		

Total Class Hours 36

Total Laboratory Hours 108

Total Suggested Clock Hours 144

I. INTRODUCTION TO ARCHITECTURAL DRAFTING

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. History of architecture
   - a. Ancient
   - b. Renaissance
   - c. American
2. Types of architecture
   - a. Traditional
   - b. Contemporary
3. Architectural lettering

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Assign frequent practice in architectural lettering as outside assignment.

II. STANDARD CONSTRUCTION

A. OUTLINE OF INSTRUCTION
Class Hours 16

1. Foundation
   - a. Preparation of ground
   - b. Footings
   - c. Foundation walls
   - d. Sills and joists
   - e. Slabs on grade
2. Framing
   - a. Platform Frames
   - b. Others
3. Finishes
   - a. Exterior
   - b. Interior

B. LABORATORY ACTIVITIES
Laboratory Hours 10

Lab assignments involving foundations, framing and finishing to meet minimum building code requirements. Part of this time spent in field trips.

III. WORKING DRAWINGS

A. OUTLINE OF INSTRUCTION
Class Hours 13

B. LABORATORY ACTIVITIES
Laboratory Hours 90

1. Preliminary consideration
    a. Lot orientation
    b. Building orientation
    c. Style
    d. Shape
    e. Size
2. Over-all planning
    a. Orientation and sizes of rooms
    b. Heating
    c. Plumbing
    d. Lighting
3. Drawings
    a. Site plans
    b. Floor plans
    c. Foundation plans
    d. Elevations
    e. Sections
    f. Details
    g. Schedules

Complete set of working drawing with details and specifications that meet building code requirements for a residence.

A complete Preliminary Plan of the class project to be furnished the students. Individual members of the class to be assigned specific working drawings to be fully developed.

IV. PERSPECTIVE

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Types
    a. One point
    b. Two point

B. LABORATORY ACTIVITIES
Laboratory Hours 4

Produce one and two point perspectives of the above residence.

V. RENDERING

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Shades

2. Shadows

B. LABORATORY ACTIVITIES
Laboratory Hours 2

Render the preceding perspectives.

VI. REVIEW

A. OUTLINE OF INSTRUCTION
Class Hours __

1. Review key areas
2. Evaluate student's command of material
3. Give additional emphasis to weak areas

B. LABORATORY ACTIVITIES
Laboratory Hours __

Assign additional laboratory applications for reinforcement.

RECOMMENDED TEXT:

Hornung, William J. *Architectural Drafting*. 3rd ed. Englewood Cliffs, New Jersey: Prentice-Hall Publisher, Inc., 1960.

SUGGESTED REFERENCES:

Dodge, F. W. *Architectural Records*. (n.p.). (n.d.).

________________________. *F.H.A. Minimum Building Requirements*. Washington, D. C.: U. S. Government Printing Office, (n.d.).

________________________. *How to Plan a House*. Chicago, Illinois: American Technical Society, (n.d.).

Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards*. 5th ed. New York: John Wiley & Sons, Inc., 1956.

Waffle, Harvey W. *Architectural Drawing*. Rev. ed. Milwaukee, Wisconsin: Bruce Publishing Company, 1962.

TDd 465

STRUCTURAL DRAFTING

5 Semester Hours

INTRODUCTION

The primary type of structure here is steel and all design problems refer to steel construction. The use of wood and concrete in design work is included in the supporting technical course, Strength of Material.

The increasing use of bolting in fabricating with a corresponding decrease in riveting is recognized and reflected through classroom and drafting room practice. Lettering practice is confined to upper-case which is used exclusively in the structural industry.

TDd 465. Structural Drafting. Two lectures. Six hours laboratory. (5 semester hours credit). The student gains a basic understanding of structural sections, terms, and conventional abbreviations and symbols used by the structural fabricators and erectors. He gains knowledge in the use of the A.I.S.C. Handbook, the tables of squares and logarithms, and trigonometric functions. Problems are assigned that involve structural designing and drawing of beams, columns, connections, trusses and bracing.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Introduction to Structural Drafting	6	5
II.	Conventional Practices	7	9
III.	Connection Design	4	0
IV.	Detail Drawing	19	94
V.	Review		

Total Class Hours 36

Total Laboratory Hours 108

Total Suggested Clock Hours 144

I. INTRODUCTION TO STRUCTURAL DRAFTING

A. OUTLINE OF INSTRUCTION
Class Hours 6

1. Types of structures
    - a. Reinforced concrete
    - b. Steel
        - (1) Wall bearing
        - (2) Beam and column
        - (3) Long-span
    - c. Wood
2. The fabrication of structural steel
    - a. Material handling and cutting
    - b. Templates
    - c. Layouts
    - d. Punching and drilling
    - e. Bolting
    - f. Riveting
    - g. Welding
    - h. Finishing, cleaning, and painting
    - i Inspection
3. Types of drawings
    - a. Design
    - b. Shop or detail
    - c. Erection

B. LABORATORY ACTIVITIES
Laboratory Hours 5

To begin this course a student should be able to do all arithmetic processes well and be able to do algebra through equations well.

Exhibit prints of the three types of drawings.

II. CONVENTIONAL PRACTICES

A. OUTLINE OF INSTRUCTION
Class Hours 7

1. Method of representation
    - a. Structural shapes
    - b. Bolts (Unfinished & High-strength)
        - (1) Shop bolts
        - (2) Field bolts
        - (3) Spacing

B. LABORATORY ACTIVITIES
Laboratory Hours 9

Select several steel shapes and have student draw the top, front, and end views, representing rivets, welds, and bolts.

    c. Welding
        (1) Shop welds
        (2) Field welds
    d. Shop rivets

2. Methods of dimensioning

    a. Differences peculiar to structural steel
        (1) Position
        (2) Fractions
        (3) Rivets and holes
        (4) Gages
        (5) Groups of similar features equally spaced
        (6) Slope
    b. Notes

3. Methods of billing

    a. Structural shapes
        (1) Conventional Abbreviations
        (2) Special abbreviations
    b. Rivets and bolts
    c. Shipping list
    d. Miscellaneous

Assign a problem involving dimensions and notes, including size, placement, position, spacing, and grouping.

III. CONNECTION DESIGN

A. OUTLINE OF INSTRUCTION
Class Hours 4

1. Beam

    a. Bolted
    b. Welded
    c. Shop weld & Field bolt

2. Truss

B. LABORATORY ACTIVITIES
Laboratory Hours 0

IV. DETAIL DRAWING

A. OUTLINE OF INSTRUCTION Class Hours 19	B. LABORATORY ACTIVITIES Laboratory Hours 94
1. Beam connections	Beam connections. Butt a small beam into a large beam using the standard connection (bolt).
a. Standard	
b. Seated	Butt a small beam into a large beam using the seated connection (bolt).
c. Methods of connecting (1) Welding (2) Riveting (3) Bolting	Butt one beam into an equal size beam using the frame connection (shop weld and field bolt). Butt a small beam into a large beam with top flange flush. (shop weld and field bolt).
2. Simple square-framed beam	
a. Dimensioning beams and connections	
b. Standard connections	Make one shop drawing of a beam connecting two parallel horizontal beams using standard connections, top flange flush. Size to be assigned.
c. Seated connection	Make one shop drawing of a beam connecting two columns (web to web) using seated connections. Size to be assigned.
d. Beam marking	
3. Column	Design and draw a four column structure with opposite hand columns. Disregard above structure.
a. Column base detail	

b. Opposite hand column c. Dimensioning d. Column markings	Include the following: a. Bolt placing plan b. Column placing plan c. Column and base plate d. Column schedule
4. Roof trusses a. Parallel cord (1) Long span (2) Short span	Complete the structural drawings for the above, designing a simple fink truss.
b. Pitched (1) Types (2) Purlins (3) Bracing (4) Bearing	Detail drawings to include: a. Truss b. Beams c. Purlins and bracing
c. Dimensioning and marking	Schedules Placing plane
5. Bracing and miscellaneous a. Diagonal bracing b. Bottom cord (1) Horizontal (2) Bottom cord c. Knee d. Headers e. Outlookers	Make detail and shop drawings of diagonal and knee bracing for the structure referred to in item 3.
6. Bill of materials a. Number b. Quantity c. Description and size d. Materials e. Remarks	Make bill of materials for the complete structure.

V. REVIEW

A. OUTLINE OF INSTRUCTION Class Hours __	B. LABORATORY ACTIVITIES Laboratory Hours __
1. Review key areas 2. Evaluate student's command of material 3. Give additional emphasis to weak areas	Assign additional laboratory applications for reinforcement.

REFERENCES:

Bishop, Carlton T. Structural Drafting. New York: John Wiley & Sons, Inc., 1941.

Giachino, J. W., and Henry J. Beukema. Drafting and Graphics. Chicago, Illinois: American Technical Society, 1961.

Parker, Harry. Simplified Roofs and Trusses for Architects and Builders. 2nd ed. New York: John Wiley & Sons, Inc., 1953.

Smoley, C. K. Smoley's Four Combined Tables. Chautauqua, New York: K. C. Smoley & Sons, 1964.

_______________. Steel Construction Manual. New York: American Institute of Steel Construction,

_______________. Structural Shop Drawing, Vol. I, II, III. New York: American Institute of Steel Construction, 1961.

TDd 474

MAP AND TOPOGRAPHIC DRAWING

4 Semester Hours

INTRODUCTION

A knowledge of surveying is a prerequisite since the draftsman will be working from specifications submitted by a surveying crew. A major division devoted to lettering indicates its importance.

All drafting media should be made available to all students and at least one assignment should be made on each material (paper, cloth, film, etc.).

TDd 474. Map and Topographic Drawing. One lecture. Six hours laboratory. (4 semester hours credit). Selected drafting techniques are applied to the problem of making maps, traverses, plot plans, plan and profile drawing using maps, field survey data, aerial photographs, and related reference materials including symbols, notations, and other applicable standardized code materials.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Introduction to Map and Topographic Drawing	4	2
II.	Lettering	1	12
III.	Traverses	3	20
IV.	Symbols	1	4
V.	Contours	2	32
VI.	Map Projection	2	0
VII.	Map Revisions	0	4
VIII.	Photogrammetry	3	30
IX.	Color Separation and Reproduction	2	4
X.	Review		

Total Class Hours 18

Total Laboratory Hours 108

Total Suggested Clock Hours 126

I. INTRODUCTION TO MAP AND TOPOGRAPHIC DRAWING

A. OUTLINE OF INSTRUCTION
Class Hours 4

B. LABORATORY ACTIVITIES
Laboratory Hours 2

1. Types of drawings and maps

   a. Geographic maps
   b. Cadastral
   c. General topographic maps
   d. Photomaps
      (1) Aerial photos
      (2) Mosaic
   e. Cartographic maps

2. Classification of information

   a. Culture (man-made)
      (1) Highways
      (2) Railroads
      (3) Towns
      (4) Fences
      (5) Buildings
      (6) Lines indicating political authority or private ownership
   b. Relief
      (1) Valleys
      (2) Hills
      (3) Plains
      (4) Plateaus
      (5) Mountains
   c. Hydrography
      (1) Oceans
      (2) Seas
      (3) Lakes
      (4) Ponds
      (5) Rivers
      (6) Creeks
   d. Vegetation
      (1) Forests
      (2) Orchards
      (3) Meadows
      (4) Crops

    (5) Deserts
    (6) Swamps and marshes

3. Scales

Exercise in use of each scale.

  a. Representative fraction RF (Representative Fraction= $\frac{\text{MD (Map Distance)}}{\text{GD (Ground Distance)}}$

  b. Words and figures

  c. Graphic representation

4. Equipment and supplies

  a. Basic drafting equipment
  b. Special equipment
    (1) Proportional dividers
    (2) Contour pen
    (3) Railroad pen
    (4) Crow-quill pen
    (5) Highway curves
    (6) Drafting machine
    (7) Pantograph
    (8) Planimeter
    (9) Lettering and symbol templates
    (10) Lettering devices Wrico, LeRoy, and Verigraph
    (11) Map projections
    (12) Stereoscopic
  c. Materials
    (1) Tracing paper, cloth, and film
    (2) Cross section and profile paper, cloth, or film
    (3) Symbol patterns
  d. Reproduction media
    (1) Photographic negatives and positives

(2) Scribing film
(3) Peel coat and cut and strip

II. LETTERING

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Freehand
    a. Vertical capital
    b. Vertical lower case
    c. Inclined capital
    d. Inclined lower case
2. Mechanical
    a. Vertical capital
    b. Vertical lower case
    c. Inclined capital
    d. Inclined lower case
3. Stick-up lettering
    a. Pre-printed
    b. Veritype
    c. Photo-lettering
4. Types of letters used
    a. Civil and political divisions
    b. Hydrography
    c. Public works
    d. Map titles
    e. North points
    f. Legends and notes
    g. Marginal information

B. LABORATORY ACTIVITIES
Laboratory Hours 12

(Outside assignment)
One plate of each of the listed lettering practices in ink. One-half of each plate to be lettered in 1/8" high letters. The remainder of the plate in $\frac{1}{4}$" high letters.

Assignment same as above using LeRoy and Wrico lettering set.

Sample maps

III. TRAVERSES

A. OUTLINE OF INSTRUCTION
Class Hours 3

B. LABORATORY ACTIVITIES
Laboratory Hours 20

1. Open traverse
    a. Plotting by polar coordinates
    b. Plotting by chords
    c. Plotting by tangents
    d. Plotting by sines
2. Closed traverse
    a. Plotting by sine, cosine, State plane coordinate, etc.
    b. Plotting by tangents and parallel ruler
3. Curved traverse

One plate open traverse using surveyors notes in method. listed.

Plot traverse by use of coordinates to a grid. Plot same traverse to more than one scale. Compute acreage of each scale by use of planimeter.

Use a ruled calculation sheet, parallel ruler, protractor, or drafting machine, and scale for each method.

Problems assigned by instructor using trigonometry tables.

Layout of curves using protractor, or drafting machine, and scale for each method.

IV. SYMBOLS

A. OUTLINE OF INSTRUCTION
Class Hours 1

1. Cultured features

    All man-made features

2. Natural features
3. Hand-make and preprinted stick-type patterns

B. LABORATORY ACTIVITIES
Laboratory Hours 4

Prepare one plate of the most commonly used cultured feature symbols.

Repeat above for natural features.

V. CONTOURS

A. OUTLINE OF INSTRUCTION
Class Hours 2

L. Contour characteristics

B. LABORATORY ACTIVITIES
Laboratory Hours 32

a. Representing terrain b. Datum plan	
2. Contour a. Definition b. Spot elevations c. Tops and depressions d. Interpolation method e. Intervals	Prepare contour maps of local area (limited) as needed for proficiency. Prepare contour map or maps assigned by instructor to include the various effects of glaciation on mountains, valleys and flat country.
3. Contour sketching Form lines	
4. Construction of profile from contours	Prepare profile from assigned topographic map.
5. Construction of contour plot from survey data. Interpolation	Prepare a contour map from profile sheets supplied by the instructor. Interpolate and plot cross sections from established center line on a topographic map sheet. Plot an assumed road template on cross section and compute end areas by planimeter and by counting squares on cross section sheet. Assign a number of lessons to inking contours by use of contour pin.

VI. MAP PROJECTION

A. OUTLINE OF INSTRUCTION
Class Hours 2

B. LABORATORY ACTIVITIES
Laboratory Hours 0

1. Types
   - a. Cylindrical
     - (1) Mercator
     - (2) Universal transverse mercator
   - b. Conic
     - (1) Polyconic
     - (2) Albers

(3) Lambert conic
c. Azimuthal (Plane)
(1) Stereographic
(2) Orthographic
(3) Lambert equal-area

VII. MAP REVISIONS

A. OUTLINE OF INSTRUCTION
Class Hours 0

1. Methods of revision by photo deletions and additions

a. Opaquing
b. Splicing
c. Engraving

B. LABORATORY ACTIVITIES
Laboratory Hours 4

VIII. PHOTOGRAMMETRY

A. OUTLINE OF INSTRUCTION
Class Hours 3

1. Preliminary work

a. Cameras
b. Planes
c. Accessories
d. Photo mission
e. Computations
f. Scales of prints
g. Flight height
h. Overlap
i. Flight lines
j. Film
k. Time required
l. Flying

2. Types of Photos

a. Vertical
b. Oblique
c. Composites

3. Photo interpretation

a. Definition

B. LABORATORY ACTIVITIES
Laboratory Hours 30

Use two or more standard techniques in the revision of selected maps.

Examine several airphoto prints and identify the features presented in lecture.

b. The technique
c. Adherent qualities
d. Tone
e. Light and shadow
f. Shape and size
g. Shadows cast
h. Relief features
i. Identifying features
j. Man-made features
    (1) Railroads
    (2) Highways
    (3) Primary highways
    (4) Secondary highways
    (5) Paths and trails
    (6) Bridges
    (7) Canals
    (8) Quarries or excavations
    (9) Buildings
    (10) Utilities
    (11) Industries
    (12) Urban areas
    (13) Agricultural patterns
k. Natural features
    (1) Woods
    (2) Brush or undergrowth
    (3) Streams
    (4) Marshes

4. Stereovision

Read and interpret Stereo-pairs with the use of a stereoscope. Draw in form lines.

a. Definition
b. Purpose
c. Stereovision ability
d. Inability
e. Methods of seeing stereoscopically
f. Aids in Stereovision
    (1) Index finger images
    (2) Paper strip images
    (3) Paper fusion strips
    (4) Fusion of dots
    (5) Depth perception
    (6) Stereo-pairs

5. Drainage area surveys
    a. Importance
    b. Prerequisites
    c. Drainage
    d. Drainage problems
        (1) Drainage channels
        (2) Dividing ridges
        (3) Placing prints
        (4) Tracing
        (5) Drainage areas

Use a polar planimeter and apply its principles. Read the vernier scale while traversing the area. Make necessary computations to determine area.

6. Aerial Mosaics
    a. Controlled
    b. Uncontrolled

Prepare uncontrolled mosaic

COMPREHENSIVE PROBLEM

Use appropriate equipment and techniques in the development of a map from above mosaic.

Ink draft above map.

IX. COLOR SEPARATION

A. OUTLINE OF INSTRUCTION
Class Hours 2

1. Overlays
    a. Registration
2. Negatives
    a. Photographic
    b. Scribe coat
3. Photomechanical
    a. Deep etch
    b. Reproduction
        (1) Photographing
        (2) Processing the negative
        (3) Press-plate preparation
        (4) Presswork

B. LABORATORY ACTIVITIES
Laboratory Hours 4

X. Review

A. OUTLINE OF INSTRUCTION
Class Hours

1. Review key areas
2. Evaluate student's command of material
3. Give additional emphasis to weak areas

B. LABORATORY ACTIVITIES
Laboratory Hours

Assign additional laboratory applications for reinforcement.

RECOMMENDED TEXT:

Sloane, Roscoe C., and John M. Montz. *Elements of Topographic Drawing*. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1943.

SUGGESTED REFERENCES:

Brown, I. W. *Manual of Class-Room Instruction in Aerial Photo Interpretation; Short Course of Study*. Jackson, Mississippi: Dixie Bookbinding Company, 1952.

Elmer, Colgate. *Map and Topographic Drafting*. College Station, Texas: Engineering Extension Service, Texas A & M, 1959.

Seelye, Elwyn. *Data Book for Civil Engineers*. 3 vols. vol. 1. *Design*. 3rd ed. New York: John Wiley & Sons, Inc., 1960.

SUPPORTING TECHNICAL COURSES FOR THE DRAFTING AND DESIGN TECHNOLOGY CURRICULA

SMa 113	Technical Math I (Algebra) *
SMa 223	Technical Math II (Trigonometry) *
SPr 213	Statics and Strength of Materials **
SSc 213	Physics I (Properties of Matter & Mechanics) *
SMa 333	Technical Math III (Analytical Geo. & Calculus) *
SMa 342	Surveying ***
SSc 323	Physics II (Electricity & Magnetism) *
SSc 433	Physics III (Heat, Light, Sound) *

*Adapted, with permission, from outlines prepared by Curriculum Laboratory, Department of Community Colleges, State Board of Education, Raleigh, North Carolina.

**Developed by Mr. Marcus D. Williams, Instructor, Civil Engineering Technology, Northwest Mississippi Junior College, Senatobia, Mississippi.

***Adapted from an outline submitted by Mr. Edward Springer, Assistant Professor of Civil Engineering, Mississippi State University, State College, Mississippi.

SMa 113. Technical Math (Algebra). Three lectures. (3 semester hours credit). Broad coverage of the most widely accepted areas of college level algebra with special applications for technicians.

MAJOR DIVISIONS

		Class Hours
I.	Number Sets	4
II.	Operations with Algebraic Expressions	8
III.	Functions and Graphical Representation	5
IV.	Linear and Quadratic Functions	8
V.	Fractions	6
VI.	Factoring	8
VII.	Graphing	7
VIII.	Exponents and Radicals	4
IX.	Imaginary and Complex Numbers	4
	Total Class Hours	54

I. Number Sets

Units of instruction--4 hours

A. Basic operations on natural numbers

B. Some properties of natural numbers

C. Representation of natural numbers on a number line

D. Basic operations of integers

E. Some properties of integers

f. Representation of integers on a number line

II. Operations with Algebraic Expressions

Units of instruction--8 hours

A. Definitions

B. Addition and subtraction with monomials

C. Addition and subtraction with polynomials

D. Use of exponents

E. Multiplication and division of monomials

F. Multiplication and division of polynomials

III. Functions and Graphical Representation

Units of instruction--5 hours

A. The coordinate system

B. The distance formula

C. Functions and relations

D. Graphical representation of functions and relations

E. Graphical representation of empirical data

IV. Linear and Quadratic Functions

Units of instruction--8 hours

A. Equalities

B. Inequalities

C. Fractional equations

D. Linear equations and formula

E. Definition of quadratics

F. Methods of solution

G. Evaluating the discriminate

H. Radical equations

V. Fractions

Units of instruction--6 hours

A. Definition

B. Fundamental principles

C. Reduction to lowest terms

D. Multiplication

E. Division

F. Signs

G. Addition and subtraction

H. Complex fractions

VI. Factoring

Units of instruction--8 hours

A. Factoring monomials

B. Prime factors

C. Multiplication of a polynomial by a monomial

D. Removing a common factor

E. The difference between two squares

F. The square of a binomial

G. Perfect square trinomials

H. Addition of a third term

I. Factoring by grouping

VII. Graphing

Units of instruction--7 hours

A. Introduction

B. The rectangular coordinate system

C. Graphing and equation

D. Solving simultaneous equations by graphs

E. Graphing equations of higher degree

VIII. Exponents and Radicals

Units of instruction--4 hours

A. Laws of exponents

B. Radical and fractional exponents

C. Multiplication and division of radical quantities

D. Addition and subtraction of radical quantities

E. Rationalizing

F. The number j

IX. Imaginary and Complex Numbers

Units of instruction--4 hours

A. Imaginary number

B. Simplifying imaginary numbers

C. The imaginary unit

D. Addition and subtraction

E. Multiplication

F. Complex numbers

G. Conjugate complex numbers

H. Addition and subtraction of complex numbers

I. Multiplication and division of complex numbers

J. Equal complex numbers

K. Graphing of complex numbers, addition and subtraction by graphing

SUGGESTED REFERENCES:

Bardell, Ross H., and Abraham Spitzbart. College Algebra. Massachusetts: Addison-Wesley Publishing Co., 1953.

Mancill, Julian D., and Mario O. Gonzalez. Modern College Algebra. New Jersey: Allyn-Bacon, Inc., 1960.

Rees, Paul K., and Fred W. Sparks. Algebra and Trigonometry. New York: McGraw-Hill Book Company, Inc., 1962.

Rosenback, J. B., Whitman, Meserve, and Whitman. Essentials of College Algebra. Massachusetts: Ginn and Company, 1958.

Vance, E. P. Modern College Algebra. Massachusetts: Addison Wesley Publishing Co., 1962.

SMa 123. Technical Math (Trigonometry). Three lectures. (3 semester hours credit). Broad coverage of the most widely accepted areas of college level trigonometry with special applications for the technician. Base common to slide rule and logarithm is examined.

MAJOR DIVISIONS

		Class Hours
I.	Radian Measure	4
II.	Trigonometric Functions	4
III.	Solution of Right Triangle	7
IV.	Identities	8
V.	Logarithms	8
VI.	Vectors	7
VII.	Oblique Triangles	6
VIII.	Inverse Functions	5
IX.	Complex Numbers	5
	Total Class Hours	54

I. Radian Measure

Units of instruction--4 hours

A. Circumference of a circle

B. The radian

C. Arc length

D. Changing from degrees to radians and radians to degrees

E. Linear and angular velocity

II. Trigonometric Functions

Units of instruction--4 hours

A. Introduction and definitions

B. Positive and negative angles

C. The rectangular Cartesian coordinate system

D. Functions and variables

E. Algebraic signs of trigonometric functions

III. Solution of Right Triangles

Units of instruction--7 hours

A. Definitions and nomenclature

B. Acute angles in a right triangle

C. Solving right triangles

IV. Identities

Units of instruction--8 hours

A. Algebraic identities

B. Fundamental relations

C. Proofs

D. Variations of basic equations

V. Logarithms

Units of instruction--8 hours

A. Definitions

B. Logarithm bases

C. Theorems on logarithms

D. Multiplying, dividing, roots, and powers

VI. Vectors

Units of instruction--7 hours

A. Arithmetic additions

B. Algebraic addition

C. Representation by line segments

D. Geometric addition

- E. Resultants and components
- F. Use of the coordinate septum
- G. Finding the resultant of two components
- H. Finding the components of a given vector

VII. Oblique Triangles

Units of instruction--6 hours

- A. The distance formula
- B. Law of cosines
- C. Law of sines
- D. The ambiguous case
- E. Law of tangents
- F. Half angle formulae

VIII. Inverse functions

Units of instruction--5 hours

- A. Definitions
- B. Inverse trigonometric functions
- C. Graphical representation
- D. Principle values
- E. Transformations

IX. Complex Numbers

Units of instruction--5 hours

- A. Definitions
- B. Cartesian form
- C. Graphical representation
- D. De Moivre's theorem
- E. Roots of complex numbers

SUGGESTED REFERENCES:

Bardell, Ross H., and Abraham Spitzbart. Plane Trigonometry. 2nd ed. Massachusetts: Addison-Wesley Publishing Company, 1964.

Hillman, Abraham P., and G. L. Alexanderson. Functional Trigonometry. New Jersey: Allyn-Bacon, Inc., 1961.

Rutledge, William A., and John A. Pond. Modern Trigonometry. 2nd. ed. Englewood Cliffs, New Jersey: Prentice-Hall, 1961.

Sparks, Fred W., and Paul K. Rees. Plane Trigonometry. 4th ed. Englewood Cliffs, New Jersey: Prentice-Hall, 1960.

SPr 213. Statics and Strength of Materials. Two lectures. Two hours laboratory. (3 semester hours credit). An introductory course into the field of structural design, consisting of a study of statics and strength of materials. Emphasis is given to elementary analysis of forces in simple structures, and a study of the properties of such materials as steel, wood, and concrete; and the design of beams, columns, and shafts with these materials.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Fundamental Terms and Definitions	2	0
II.	Resultant and Equilibrant of Forces	6	8
III.	Moments	2	2
IV.	Nonconcurrent Coplanar Forces (Trusses)	6	8
V.	Concurrent Noncoplanar Forces	2	2
VI.	Static and Kinetic Friction	2	2
VII.	Simple Stresses	2	2
VIII.	Properties of Materials	2	2
IX.	Riveted and Welded Joints and Thin Walled Cylinders	2	2
X.	Center of Gravity, Centroids, and Moments of Inertia	3	2
XI.	Beam Design	4	3
XII.	Column Design	3	3
		Total Class Hours 36	Total Laboratory Hours 36

Total Suggested Clock Hours 72

I. Fundamental Terms and Introduction

Units of instruction--2 hours

A. History

1. Introduction to mechanics

2. Basic terms

II. Resultant and Equilibrant of Forces

Units of instruction--6 hours

A. Forces
   1. External forces
   2. Internal forces
   3. Collinear forces
   4. Concurrent forces
   5. Transmissibility of forces

B. Types of force systems
   1. Resultant and concurrent forces
   2. Resultant and collinear forces
   3. Equilibrium of forces

C. Action and reaction
   1. Tension and compression
   2. Resultant of two concurrent forces

D. Equilibrant and the force triangle
   1. Graphical solution of force triangles
   2. Mathematical solution of force triangles

E. Free body concept
   1. Analysis by free body method
   2. Graphic solutions

F. Component forces
   1. Graphical solution
   2. Mathematical solution

G. Equilibrant of More Than Two Forces
   1. Graphical solution
   2. Mathematical solution

III. Moments

Units of instruction--2 hours

A. Moments
   1. Definition
   2. Signs of moments
   3. Moments of parallel forces

B. Summation of force method
   1. Moment solutions
   2. Summation of force solutions
   3. Couples

IV. Nonconcurrent Coplanar Forces (Trusses)

Units of instruction--6 hours

A. Resultant forces

B. Trusses and their use

C. Solution of truss forces
   1. Method of joints
   2. Method of sections
   3. Method of shear
   4. Summation of forces method

V. Concurrent Noncoplanar Forces

Units of instruction--2 hours

        1. Conditions of equilibrium forces in three dimension
        2. Resultant and equilibrant forces in three dimension

VI. Static and Kinetic Friction

    Units of instruction--2 hours

    A. Friction
        1. Introduction
        2. Static friction
        3. Kinetic friction
        4. Wedge friction
        5. Journal friction

VII. Simple Stresses

    Units of instruction--2 hours

    A. Elastic concept
    B. Stress determination single material
    C. Composite materials

VIII. Properties of Materials

    Units of instruction--2 hours

    A. Definitions and terms
    B. Tension properties
    C. Compression properties
    D. Poisson's Ratio
    E. Modulus of elasticity

IX. Riveted and Welded Joints and Thin Wall Cylinders

    Units of instruction--2 hours

    A. Riveted joints
        1. Stresses in riveted joints

        2. Types of failures
        3. Efficiency of riveted joints
    B. Welded joints
        1. Butt welds
        2. Lap welds
        3. Stress in welds
    C. Thin wall cylinders
        1. Wall stress
        2. Longitudinal stresses

X. Center of Gravity, Centroids, and Moments of Inertia

Units of instruction--3 hours

- A. Centroids
    - 1. Regular geometric shapes
    - 2. Irregular geometric shapes
- B. Center of gravity
    - 1. Regular geometric shapes
    - 2. Irregular geometric shapes
- C. Moment of inertia
    - 1. Regular geometric shapes
    - 2. Irregular geometric shapes

XI. Beam Design

Units of instruction--4 hours

- A. Shear
    - 1. Shear forces
    - 2. Shear diagrams

- B. Moments
  - 1. Moments in a beam
  - 2. Moment diagrams
- C. Loads on beams
  - 1. Live
  - 2. Static
- D. Beam design
  - 1. Bending stresses
  - 2. Shear stresses
  - 3. Moment method
  - 4. Section modulus method
  - 5. Steel beams
  - 6. Wood beams
  - 7. Concrete beams

XII. Column Design

Units of instruction--3 hours

- A. Stresses in columns
  - 1. Short columns
  - 2. Intermediate columns
  - 3. Long columns
  - 4. Slenderness ratio
- B. Design of columns
  - 1. Steel columns
  - 2. Wood columns
  - 3. Concrete columns

SUGGESTED TEXT:

Bassin, Milton G., and Stanley M. Brodsky. *Statics & Strength of Materials*. New York: McGraw-Hill Book Company, Inc., 1960.

SUGGESTED REFERENCES:

Goff, Robert H., and Donald E. Hardenbergh. *Introduction to Engineering Statics*. New York: Holt, Rinehart, & Winston, 1964.

Harris, Charles O. *Strength of Materials*. 2nd ed. Chicago: American Technical Society,

Jensen, Alfred. *Statics and Strength of Materials*. New York: McGraw-Hill Book Company, Inc., 1962.

Parker, Harry. *Simplified Mechanics and Strength of Materials*. 2nd ed. New York: John Wiley and Sons, Inc., 1961.

Timoshenko, Stephen, D. H. Young. *Elements of Strength of Materials*. 4th ed. Princeton, New Jersey: D. Van Nostrand Company, Inc., 1962.

Trathen, Roland H. *Statics and Strength of Materials*. New York: John Wiley and Sons, Inc., 1954.

SSc 313. Physics (Properties of Matter and Mechanics). Two lectures. Two hours laboratory. (3 semester hours credit). A fundamental course covering several basic principles of physics such as the nature of scientific measurement and the most widely used systems, properties of matter including elementary atomic structure and the states of matter, mechanics and basic machines, and the solution of problems related to these areas. Laboratory periods will be used for demonstration and student experiments.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Introduction	2	1
II.	Measurement	4	2
III.	Atoms and Molecules	2	2
IV.	Properties and Phenomena of Solids	3	4
V.	Properties and Phenomena of Liquids	3	4
VI.	Properties and Phenomena of Gases	4	6
VII.	Vectors and Graphic Solutions	2	3
VIII.	Force and Motion	3	2
IX.	Work, Energy, and Power	4	2
X.	Analysis of Basic Machines and Friction	6	8
XI.	Rotation, Torque, and Power Transmission	3	2
		Total Class Hours 36	Total Laboratory Hours 36

Total Suggested Clock Hours 72

I. Introduction

Units of instruction--2 hours

A. Physics: a study of matter and energy

1. Matter
    a. Solid
    b. Liquid
    c. Gas

2. Energy
    a. Forms
        (1) Potential
            (a) Chemical
            (b) Position
            (c) Nuclear
        (2) Kinetic
            (a) Motion (Momentum)
            (b) Heat
            (c) Light
            (d) Sound
            (e) Electrical
    b. Conversion

B. Mathematics for physics

1. Decimals
2. Exponents
3. Trigonometric functions
    a. Sin alpha
    b. Cos alpha
    c. Tan alpha
4. Graphs, design and interpretation
5. The slide rule, a, b, c, d, k, and l scale
    a. Multiplication
    b. Division
    c. Squares and cubes
    d. Square root and cube roots
    e. Logarithms

C. Symbols and terms

D. Problem solving

1. Drawing of simple diagram
2. Listing of known and sought-after quantities
3. Type of problem and equation(s) needed
4. Substitution of letters for numbers
5. Cancelling and solving algebraically
6. Determining and giving unit for each number solved
7. Consideration of reasonableness of values obtained

II. Measurement

Units of instruction--4 hours

A. Fundamental units of measurement

1. Length

- a. English
    - (1) Inch
    - (2) Foot
    - (3) Yard, 3600/3937 meter
    - (4) Rod
    - (5) Mile
- b. Metric
    - (1) Angstrom
    - (2) Micron
    - (3) Millimeter
    - (4) Centimeter
    - (5) Decimeter
    - (6) Meter, standard unit of length for world
        - (a) Old standard estimated to be 1/10,000,000 distance fron North Pole to equator
        - (b) New standard, 1,650,763.73 wavelengths of the orange-red line of krypton 86
    - (7) Kilometer
- c. Conversion factors
    - (1) 1 inch = 2.54×10^{-2} meter
    - (2) 1 Meter = 39.37 inches

2. Mass
    - a. English
        - (1) Pound
        - (2) Slug
        - (3) Conversion
    - b. Metric
        - (1) Milligram
        - (2) Gram
        - (3) Kilogram
        - (4) Metric ton
    - c. Conversion factors
        - (1) 1 Kilogram = 2.205 pounds (mass)
        - (2) 1 slug = 14.6 Kilograms
3. Time - second

B. Secondary units of measure

1. Area
    - a. English
        - (1) Square inch
        - (2) Square foot
        - (3) Acre
    - b. Metric
        - (1) Square centimeter
        - (2) Square meter
2. Volume
    - a. English
        - (1) Fluid ounce

            - (2) Quart
            - (3) Gallon
            - (4) Cubic foot
        - b. Metric
            - (1) Milliliter
            - (2) Liter

C. Systems of units

- 1. English
    - a. Foot-Pound-Second (F.P.S.)
    - b. Foot-Slug-Second (F.S.S. or British Engineering)
- 2. Metric
    - a. Centimeter-gram-second (C.G.S.)
    - b. Meter-kilogram-second (M.K.S.)
- 3. Table of corresponding units of each of the four systems of units

D. The art of measurement

- 1. Closeness of measurement
- 2. The doubtful figure: tolerance
- 3. Significant figure
- 4. One part in so many
- 5. Accuracy of measurement
- 6. Percentage of error
- 7. Percentage deviation from the mean

E. Measuring devices

- 1. Length
    - a. Scaled straight edge
    - b. Calipers and dividers
    - c. Micrometer caliper
        - (1) Least count
        - (2) Reading
    - d. Vernier caliper
        - (1) Least count (vernier)
        - (2) Reading
    - e. Gauge blocks
    - f. Optical flats
- 2. Area: compensating polar planimeter
- 3. Volume: specific gravity bottles, pyknometers
- 4. Mass
    - a. Trip balance
    - b. Beam balance
    - c. Analytical balance
    - d. Inertia balance
- 5. Force--spring balance

6. Time
    a. Stop clock
    b. Stop watch
7. Direction
    a. Units
        (1) Degree
        (2) Radian
    b. Measurement
        (1) Protractor
        (2) Theodolite
    c. Scales
        (1) Navigator's
        (2) Mathematician's and scientist's

III. Atoms and molecules

Units of instruction--2 hours

A. Structure of matter

1. Atoms
    a. Electron - orbits
    b. Nucleus
        (1) Protons
        (2) Neutrons
2. Molecules
3. Compounds
4. Mixtures

B. States of matter

1. Solid
2. Liquid
3. Gas

C. Forces among molecules

1. Cohesion
2. Adhesion
3. Capillary action

D. Molecules in motion

1. Brownian movement
2. Diffusion
3. Osmosis
4. Kinetic theory

IV. Properties and phenomena of solids

Units of instruction--3 hours

A. Density

1. Mass
2. Weight

B. Elasticity

1. Tensional
2. Compressional
3. Torsional
4. Shear
5. Bending

C. Stress

D. Strain

E. Hooke's Law

F. Young's Modulus

1. Ration of stress to strain
2. Elastic limit

G. Hardness, malleability, ductility, and tensile strength

Rockwell & Brunell hardness scales.

H. The effect of heat

1. Linear expansion
2. Area expansion
3. Volumetric expansion

V. Properties and phenomena of liquids

Units of instruction--3 hours

A. Pressure

1. Measurement
2. Calculation
3. Pascal's Vases
4. Head

B. Forces in fluids

      1. Archimedes' principle
      2. Bernoulli's principle

   C. Physical

      1. Viscosity
      2. Volatility
      3. Specific gravity: hydrometer
      4. Density

   D. Hydraulics

      1. Hydraulic press
      2. Pumps
         a. Centrifugal
         b. Lift
         c. Force
         d. Gear
      3. Motors (hydraulic driven)

VI. Properties of gases

Units of instruction--4 hours

A. Elasticity and compressibility

1. Boyle's Law
2. Charles' Law
3. Gemeral gas law

B. Pressure

1. Vacuum
2. Atmospheric
3. Absolute

C. Pressure gauge

1. Barometer
   a. Mercury
   b. Aneroid: altimeter
2. Bourdon gauge

VII. Vectors and graphic solutions

Units of instruction--2 hours

A. Vectors

1. Quantity representation
2. Parallelogram of forces
3. Equilibrium of forces
4. The vector triangle
5. Vector polygon
6. Vectors applied to structural problems
   a. Condition I (translational)
   b. Condition II (rotational)
7. Equilibrium due to concurrent forces
   a. Tension
   b. Compression

VIII. Force and motion

Units of instruction--3 hours

A. Force

1. Definition
2. The force of gravitation
   a. Sir Issac Newton--universal law of gravitation
   b. Gravity's relation to weight
   c. Means of measuring

B. Concept of motion

1. Velocity--the time rate of displacement
2. Acceleration
   a. Positive
   b. Negative
3. Velocity and acceleration
4. Distance and acceleration
5. Acceleration due to the force of gravity
   a. Free fall motion
   b. Ballistic problems

C. Newton's laws of motion

1. First law--inertia
2. Second law--acceleration
3. Third law--action and reaction

IX. Work, energy, and power

Units of instruction--4 hours

A. Work

1. Definition

- 2. Units of work
    - a. Metric
    - b. English

B. Energy

- 1. Classification
    - a. Kinetic energy
        - (1) Electrical
        - (2) Heat
        - (3) Sound
        - (4) Light
        - (5) Mechanical
    - b. Potential energy
        - (1) Chemical
        - (2) Positional
        - (3) Nuclear
- 2. Measurement of energy
    - a. Metric
    - b. English
- 3. Energy and its transformations
    - a. Original sources
        - (1) Sun
        - (2) Atom
    - b. Conversion to other forms
- 4. Law of conservation of energy

C. Momentum

- 1. Impulse
- 2. Impact of moving fluids
- 3. Momentum and Newton's third law
    - a. The law of conservation of momentum
    - b. Rockets and jets

D. Power

- 1. Definition
- 2. Units of power
- 3. Efficiency
- 4. Measuring horsepower
    - a. Brake horsepower: the pony brake
    - b. The dynamometer

X. Analysis of basic machines and friction

Units of instruction--6 hours

A. Basic machines

1. The lever
    a. Mechanical advantage
        (1) Actual
        (2) Theoretical
    b. Examples and types
2. The inclined plane
    a. Vectorial analysis
    b. Applications

B. Friction

1. Nature of friction
2. Analyzing frictional forces
3. Coefficient of friction
    a. Starting
    b. Sliding
    c. Rolling
4. Effect of friction of machines
5. Mechanical advantage and efficiency of machines

C. Modification of the basic machines

1. The wedge
    a. Types
    b. Theoretical mechanical advantage
2. Screws
    a. Terminology
    b. Applications
    c. Mechanical advantage
    d. Efficiency
3. Wheel and axle
    a. Theoretical mechanical advantage
    b. Actual mechanical advantage
    c. Applications
4. Pulleys
    a. Simple
    b. Compound
    c. Chain fall
    d. Power transmitting - variable pitch
5. Gears
    a. Types
    b. Ratios

D. Compound machines

XI. Rotation, torque, and power transmission

Units of instruction--3 hours

A. Rotary motion

   1. Rotation as opposed to translation
   2. Angular measurements
      a. Displacement
      b. Velocity
      c. Acceleration

B. Torque

   1. Units of torque
   2. Contrast to work
   3. Applications

C. Power transmission

   1. Work and power in rotary motion
   2. Drive shafts

D. Centripetal force

   1. Uniform circular velocity
   2. Circular acceleration
   3. Relationship of Newton's first law of motion
   4. Relationship of Newton's second law of motion
   5. Applications

E. Centrifugal force

   1. Relationship of Newton's third law of motion
   2. Industrial applications

SUGGESTED TEXT:

Harris, Norman, and Edwin M. Hemmerling. Introductory Applied Physics. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1963.

or

White, Marsh, Kenneth V. Manning, and Robert L. Weber. Practical Physics. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1955.

SUGGESTED REFERENCES:

Dull, Charles E., H. Clark Metcalfe, and William O. Brooks. Modern Physics. New York: Holt, Rinehart, and Winston, 1963.

Githens, Sherwood, Jr. Introduction to Physics. Part I: Techniques and Tools of the Physicist and Engineer. Durham: Sherwood Githens, Jr., 1961.

Githens, Sherwood, Jr. Introduction to Physics. Part II: Mechanics and Properties of Matter. Durham: Sherwood Githens, Jr., 1961.

Githens, Sherwood, Jr., Introduction to Physics. Part III: Magnetism, Electricity, Periodic Functions, Wave Motion and Electronics. Durham: Sherwood Githens, Jr., 1961.

White, Harvey E. Physics, An Exact Science. Princeton, New Jersey: D. Van Nostrand Company, Inc., 1959.

SMa 333. Technical Math (Analytical Geometry & Calculus). Three lectures. (3 semester hours credit). Basic analytical geometry and calculus, including limits, derivations, and integrations; mechanics of La Place operational calculus as related to the study of control circuits; problem assignments illustrating applications; oscilloscope demonstrations showing mathematical interpretation of electric waveforms; differentiation and integration to provide an understanding of expressions frequently encountered in technical literature.

MAJOR DIVISIONS

		Class Hours
I.	Graphical Methods of Calculus	3
II.	The Functions	2
III.	Differentiation	17
IV.	Differentiation of Higher Order	2
V.	Integration	17
VI.	Additional Trigonometric Functions in Calculus	10
VII.	Logarithmic and Exponential Functions	3
	Total Class Hours	54

I. Graphical Methods of Calculus

Units of instruction--3 hours

A. Slopes and rate of change

B. Increments--work force diagrams

C. Nonlinear equations--slopes

D. The derivative graphically

II. The Functions

Units of instruction--2 hours

A. Variables and constants

B. Dependent and independent variables

C. Continuous functions

D. Single value

E. Explicit and implicit

III. Differentiation

Units of instruction--17 hours

A. Algebraic methods

B. Limits

C. General rules

D. Where $X = f(y)$

E. Where $X = f (y)n$

F. Sum or difference

G. Maximum and minimum values

H. Basic trigonometric functions

I. $Y = e^u$ where $u = f (x)$

J. Repeated differentiation

IV. Differentiation of Higher Order

Units of instruction--2 hours

A. Second derivative

B. Application to falling bodies

V. Integration

Units of instruction--17 hours

A. Introduction of integration

B. The integration constant

C. The mechanics of indefinite integral

D. Evaluation of the constant of integration

E. Integrals

F. The integral applied to acceleration

G. Area determination with integrations

H. Average values by integration

I. Integration of basic trigonometric functions

J. Volumes by integration

VI. Additional Trigonometric Functions in Calculus

Units of instruction--10 hours

A. Inverse functions

B. Electrical application of waves to differentiation and integration circuits

VII. Logarithmic and Exponential Functions

Units of instruction--3 hours

A. Exponential function

B. Exponential functions in calculus

C. Electrical transients

SUGGESTED REFERENCES:

Cooke, Nelson M., and Joseph B. Orleans. *Mathematics Essential to Electricity and Radio*. New York: McGraw-Hill Book Company, Inc., 1943.

Fischer, Bernhard, and Herbert V. Jacobs. *Elements of Mathematics for Radio, Television, and Electronics*. New York: Macmillian Book Company, 1954.

Freilich, Julius, and others. *Algebra for Problem Solving, Book I and II*. New York: Houghton Mifflin Book Company, [n.d.].

Harris, Charles O. *Slide Rule Simplified*. 2nd ed. Chicago, Illinois: American Technical Society, [n.d.].

Keasey, Miles A., George A. Kline, and David A. McIlhattan. *Engineering Mathematics*. New York: The Blakiston Company, [n.d.].

Nodelman, H. M., and F. Smith. *Mathematics for Electronics with Applications*. New York: McGraw-Hill Book Company, Inc., [n.d.].

Rice, Harold S., and Raymond M. McKnight. *Technical Mathematics*. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1963.

Richardson, Moses. *Fundamentals of Mathematics*. Rev. ed. New York: Macmillian Book Company, 1958.

Richmond, Allan E. *Calculus for Electronics*. New York: McGraw-Hill Book Company, Inc., 1958.

Singer, B. B. *Basic Mathematics for Technical Courses*. Englewood Cliffs, New Jersey: Prentice-Hall Publisher, Inc., [n.d.].

SMa 342 Surveying. One hour lecture. Two hours laboratory. (2 semester hours credit). A familiarization laboratory designed to develop in the drafting student the ability to take surveyor's notes and convert them into finished drawings. It includes basic principles of geometry, theory, and use of instruments, mathematical calculations, and the control and reduction of errors.

NOTE: The suggestion has been made that this course be offered in the spring semester. After the student has gained sufficient background in theory and has familiarized himself with the instruments, the spring weather will permit the assignment of a comprehensive field problem.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Introduction to Surveying	1	0
II.	Measurements of Distance	2	2
III.	Leveling	2	6
IV.	Angular Measurements and Traverses	4	12
V.	Computations	4	10
VI.	Stadia	1	2
VII.	Topographic Surveying	2	4
VIII.	Land Surveying	2	0

Total Class Hours 18

Total Laboratory Hours 36

Total Suggested Clock Hours 54

I. Introduction to Surveying

Units of instruction--1 hour

1. Definition
2. Kinds of surveying
3. Precision and accuracy
4. Mistakes and errors

5. Field notes

6. Error analysis

II. Measurements of Distance

A. Units of instruction--2 hours

1. Instruments

Emphasize the care and use

2. Field procedure

3. Correction and reduction of errors

4. Mistakes and checks

5. Specifications for desired accuracy

6. Electronic Distance Measuring Devices

B. Laboratory Activities--2 hours

Chain the distance, record measurements, and make pertinent notes, such as temperature, etc.

III. Leveling

A. Units of instruction--2 hours

1. Principles

a. Definitions

b. Curvature and refraction

c. Theory and principles of instruments

d. Types of instruments

2. Application

a. Differential profile and reciprocal circuits

b. Care and adjustment of instrument

        - c. Errors and mistakes
        - d. Field notes and checks
        - e. Accuracy and classification

- B. Laboratory Activities--6 hours

  Complete level transverse circuit; record and plot data.

IV. Angular Measurements and Traverses

- A. Units of instruction--4 hours
    - 1. Principles
        - a. Theory
        - b. Aximuths and bearings
        - c. Magnetic field and declination
        - d. Reference meridians
        - e. Instruments
        - f. Angular measurements
    - 2. Application
        - a. Operation of the transit
        - b. Verniers
        - c. Adjustment and care of instruments
        - d. Types of traverses
        - e. Mistakes and errors
        - f. Field notes and checks
        - g. Classification of surveys and required accuracy

B. Laboratory Activities--12 hours

Make angular measurements of traverse exercise; record and plot data.

V. Computations

A. Units of instruction--4 hours

1. General considerations

a. Significant figures and consistant accuracy

b. Office procedure

c. Latitudes, departures, and coordinates

d. Adjustments

2. Methods

a. Areas

b. Coordinates

c. DMD's

d. Simpson 1/3 rule

e. Trapezoid rule

f. Triangulation, Planimeter, Volumes

g. Prismoidal method

h. Average endarea method

i. Borrow pit method

B. Laboratory Activities--10 hours

Adjust survey traverse data. Consider error of closure.

VI. Stadia

A. Units of instruction--1 hour

1. Principles
    a. Theory and definitions
    b. Derivations
    c. Accuracy
    d. Errors and mistakes
2. Applications
    a. Topographic and planimetric mapping
    b. Traversing
    c. Leveling

B. Laboratory Activities--2 hours

Run typical stadia line.

VII. Topographic Surveying

A. Units of instruction--2 hours

1. General
    a. Characteristics and location of contours
    b. Horizontal and vertical control
    c. Triangulation
2. Drafting
    a. Components of a map
    b. Legends and symbols
    c. Map scales and contour intervals
    d. Map layout and plotting
    e. Engineering application of maps
    f. Required accuracy
    g. Checks on field work

B. Laboratory Activities--4 hours

Establish 100 ft. grid system, take spot elevation and prepare contour plot map.

VIII. Land Surveying

A. Units of instruction--2 hours

1. Public lands system
    - a. History
    - b. Instruments and field methods
    - c. Methods of division
    - d. Corners and corner materials
2. Legal aspects
    - a. Authority of the surveyor
    - b. Kinds of deeds and deed descriptions
    - c. Reparian rights
    - d. Adverse possession
    - e. Survey records
3. Field procedure
    - a. What present surveys reveal
    - b. Restoration of lost and obliterated corners
    - c. Field surveys and checks
    - d. Plats

SUGGESTED REFERENCES:

Barry, B. Austin. Engineering Measurements. New York: John Wiley & Sons, Inc., 1964.

Breed, Charles B., and George L. Hosmer. Principles and Practice of Surveying. 9th ed. New York: John Wiley & Sons, Inc., 1958.

Breed, Charles B. Surveying. 2nd ed. New York: John Wiley & Sons, Inc., 1957.

Davis, Raymond E. Elementary Plane Surveying. 3rd ed. New York: McGraw-Hill Book Company, Inc., 1955.

Kissam, Philip. Instruments and Methods for Surveys. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1956.

Kissam, Philip. Surveying for Civil Engineers. New York: McGraw-Hill Book Company, Inc., 1956.

Le Gault, Arian R., Howard M. McMaster, Woodward Clyde, and Ralph R. Marlette. Surveying: An Introduction to Engineering Measurements. New Jersey: Prentice-Hall, Inc., 1956.

Pafford, F. William. Handbook of Survey Notekeeping. New York: John Wiley & Sons, Inc., 1962.

Pickles, George W., and Carrol C. Wiley. Route Surveying. 3rd ed. New York: John Wiley & Sons, Inc., 1949.

Smernoff, Michael V. Measurements for Engineering and Other Surveys. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1961

SSc 323. Physics (Electricity and Magnetism). Two lectures. Two hours laboratory. (3 semester hours credit). Concepts in basic electricity and magnetism with technical applications.

MAJOR DIVISIONS

		Class Hours	Laboratory Hours
I.	Magnetism and Electricity	4	2
II.	Basic Electrical Units and Circuits	5	6
III.	Sources and Effects of Electric Current	3	4
IV.	Electromagnetism	5	4
V.	Electromagnetic Induction	5	2
VI.	Alternating Current	5	6
VII.	Generators and Motors	3	4
VIII.	Production and Distribution of Electric Power	3	4
IX.	Industrial Electronics	3	4
		Total Class Hours 36	Total Laboratory Hours 36

Total Suggested Clock Hours 72

I. Magnetism and Electricity

Units of instruction--4 hours

A. Magnets

1. Natural

2. Artificial

B. Magnetic poles

1. N - north seeking

2. S - south seeking

3. Laws of attraction or repulsion

C. Magnetic fields

    1. Lines of force
    2. Earth's magnetic field
    3. Interactions of fields of force
- D. Electrostatics
    1. Definition
    2. Examples
- E. Electrification
    1. Positive and negative charges
    2. Methods of producing static electricity
- F. Electron theory of electricity
    1. Electrons
    2. Protons
    3. Nucleus
- G. Electrical paths
    1. Conductors
    2. Insulators
- H. Electroscope
    1. Charging
    2. Discharging
    3. Theory
- I. Electrical storehouses
    1. Leyden jar
    2. Capacitors

II. Basic Electrical Units and Circuits

Units of instruction--5 hours

A. Electric currents

    1. Definition

    2. Unit of measure

B. Voltage

    1. Potential differences

    2. Unit of measure

C. Resistance

    1. Types of resistors

    2. Unit of measure

D. Ohm's law

    1. Stated

    2. Analyzed

E. Measuring electrical quantities

    1. Potential difference - the voltmeter

    2. Current - the ammeter

    3. Resistance

        a. Ohmmeter
        b. Wheatstone bridge
        c. Ammeter - voltmeter method

F. Series circuits

    1. Current

    2. Voltage

    3. Resistance

G. Parallel circuits

    1. Current

        2. Voltage

        3. Resistance

    H. Series-parallel circuits

        1. Current

        2. Voltage

        3. Resistance

III. Sources and Effects of Electric Current

Units of instruction--3 hours

- A. Properties of electric current
  - 1. Causes of electron flow
  - 2. Direction of electron flow
  - 3. Method of electron flow
    - a. Through solids
    - b. Through liquids
    - c. Through gases
- B. Producing electrical currents
  - 1. Chemical means - voltaic cells
    - a. The dry cell
      - (1) Polorization
      - (2) Local action
    - b. The storage cell
      - (1) Lead-acid cells
      - (2) Alkaline cells
  - 2. Electromagnetic generators
  - 3. Photoelectricity
  - 4. Thermoelectricity
- C. The effects of electric currents
  - 1. Chemical

2. Magnetic

3. Heating

D. Electrical power and energy

1. Definitions

2. Units

a. Watt and Kilowatt
b. Watt-hour and Kilowatt-hour

3. Electrical energy equivalent to heat energy

IV. Electromagnetism

Units of instruction--5 hours

A. Magnetic fields

1. Around a straight conductor

2. Around a loop

3. Left hand rule

B. Electromagnets

1. Iron core

2. Residual magnetism

3. Commerical uses

C. Electrical measuring instruments

1. Measuring effects

a. Chemical
b. Heating
c. Magnetic

2. Motor rule

3. Galvanometers

4. Ammeters

5. Voltmeters

6. Alternating current instruments

V. Electromagnetic Induction

Units of instruction--5 hours

A. Michael Faraday contributions

1. Mechanical energy to electrical energy

2. Importance of his discovery

B. Magnetic induction terminology

1. Magnetic flux

2. Flux density

3. Permeability

4. Field strength

C. Induced electromotive forces

1. Lenz's law

2. Mutual inductance

3. Self-induction

VI. Alternating Current

Units of instruction--5 hours

A. Introduction to alternating current

1. Nature of alternating current

2. Alternating current compared with direct current

3. Cycles--frequency

4. Effective current and voltage

B. Properties of alternating-current circuits

1. Pure-resistive circuits

2. Inductive circuits

3. Resistance and inductance -- impedance

4. Capacitive reactance circuits

5. Resistive, capacitive, and inductive circuits

6. Power factor

C. Transformers

1. Structure

a. Primary coil
b. Secondary coils
c. Cores

2. Theory

a. Formation of magnetic field
b. Induced electromotive force

3. Types of transformers

a. Step-up voltages
b. Step-down voltages

4. Uses of transformers

a. Power transmission over long distances
b. Low voltage-heavy current supply
c. Low voltage control circuits

5. Losses

a. Eddy currents
b. Hysterisis

VII. Generators and Motors

Units of instruction--3 hours

A. Direct-current generators

1. Components

a. Field

        - b. Brushes
        - c. Commutator
    - 2. Principle of operation

- B. Direct-current motors
    - 1. Construction
    - 2. Theory of operation
    - 3. Counter electromotive force

- C. Alternating current generators
    - 1. Construction
        - a. Rotor
        - b. Stator
    - 2. Phase
        - a. Single
        - b. Three
            - (1) Delta
            - (2) Y (wye)

- D. Types of alternating current motors
    - 1. Series
    - 2. Shunt
    - 3. Compound
    - 4. Induction
    - 5. Synchronous

- E. Measurement of A-C Energy Consumption

VIII. Production and Distribution of Electric Power

Units of instruction--3 hours

- A. Terminology
    - 1. Coulomb

2. Electron power

3. Kilovolt-ampere

B. Production of electric power

1. Steam plants

2. Internal-combustion-engine plants

3. Hydro-electric plants

4. Atomic energy plants

C. Design and operation of alternators

1. Advantages and disadvantages of three-phase alternators

2. General construction

a. Armature
b. Stator

3. Field excitation

4. Connecting alternators to the line

D. Transmission of electric power

1. Types of transmission

2. Principal losses

a. Line
b. Leakage
c. Transformer

3. Transformers for power transmission

4. Substations

IX. Industrial Electronics

Units of instruction--3 hours

A. Vacuum tube

1. History of discovery

    2. Thermionic emission

    3. Diodes

    4. Triodes

        a. Voltage amplifiers
        b. Power amplifiers

    5. Rectification

    6. Audio-frequency amplifiers

B. Semi-conductors

C. Applied electronics

    1. Frequency controls

    2. Radio and television

    3. X-rays

SUGGESTED TEXT:

Harris, Norman, and Edwin M. Hemmerling. *Introductory Applied Physics*. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1963.

SUGGESTED REFERENCES:

Dull, Charles E., H. Clark Metcalfe, and William O. Brooks. *Modern Physics*. New York: Holt, Rinehart, and Winston, 1963.

Githens, Sherwood, Jr. *Introduction to Physics*. *Part I*: *Techniques and Tools of the Physicist and Engineer*. Durham: Sherwood Githens, Jr., 1961.

Githens, Sherwood, Jr. *Introduction to Physics*. *Part II*: *Mechanics and Properties of Matter*. Durham: Sherwood Githens, Jr., 1961.

Githens, Sherwood, Jr. *Introduction to Physics*. *Part III*: *Magnetism*, *Electricity*, *Periodic Functions*, *Wave Motion and Electronics*. Durham: Sherwood Githens, Jr., 1961.

White, Harvey E. *Physics*, *An Exact Science*. Princeton, New Jersey: D. Van Nostrand Company, Inc., 1959.

White, Marsh, Kenneth V. Manning, and Robert L. Weber. *Practical Physics*. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1955.

SSc 423. Physics (Heat, Light, and Sound). Two lectures. Two hours laboratory. (3 semester hours credit). An examination of the theory and applications of temperature and heat, the most widely accepted scales of measurement, sound and wave motion, light and illumination, optical measurement, and the nature of atomic theory.

MAJOR DIVISIONS		Class Hours	Laboratory Hours
I.	Temperature and Heat	7	8
II.	Sound and Wave Motion	8	10
III.	Light and Illumination	9	6
IV.	Principles of Optical Measurement	7	8
V.	Atomic Energy	5	4
		Total Class Hours 36	Total Laboratory Hours 36

Total Suggested Clock Hours 72

I. Temperature and heat

Units of instruction--7 hours

A. Temperature

1. Definition
2. Measurement
   - a. English
     - (1) Fahrenheit
     - (2) Rankine
   - b. Metric
     - (1) Centigrade
     - (2) Kelvin or Absolute
   - c. Conversion
   - d. Thermometers
     - (1) Liquid
     - (2) Gas
     - (3) Resistance
     - (4) Thermoelectric
     - (5) Pyrometer
       - (a) Optical
       - (b) Radiation

B. Heat

1. Definition
2. Contrasted with temperature
3. Measurement
    a. English: British Thermal Unit
    b. Metric
        (1) calorie
        (2) Calorie
    c. Calorimeter
4. Specific heat and thermal capacity
5. Law of heat exchange
6. Change of state
    a. Latent heat of fusion
    b. Melting and freezing
    c. Latent heat of vaporization
    d. Evaporation, boiling, and condensation
    e. The effect of pressure
7. Heat transfer
    a. Definition
    b. Direction
    c. Methods
        (1) Convection
            (a) Forced
            (b) Natural
        (2) Radiation
            (a) Light and dark surfaces
            (b) Polished and dull surfaces
        (3) Conduction

II. Sound and wave motion

Units of instruction--8 hours

A. Wave characteristics

1. Source
2. Frequency
3. Amplitude
4. Length
5. Velocity
    a. Effect of medium
    b. Effect of temperature

B. Transverse waves

1. Motion
2. Applications

C. Longitudinal waves

    1. Rarefaction
    2. Condensation

D. Musical tones

    1. Pitch
    2. Wave characteristics of harmony

E. Calculations

F. Technical applications of sound waves

    1. Reflection
        a. Measurements
        b. Supersonics
    2. Refraction
    3. Seismograph applications
    4. Absorption of sound
        a. Coefficients
        b. Materials
    5. Reproduction of sound
        a. Recordings
            (1) Wax
            (2) Wire
            (3) Tape
        b. On film
    6. Resonance

III. Light and illumination

Units of instruction--9 hours

A. Early theories

B. Present theories accounting for light properties

    1. Wave (polarization)
    2. Quantum

C. Velocity of light

D. Illumination calculations

    1. Intensity (units of)
    2. Effect of distance
        a. Photometer
        b. Foot candle meter

E. Color - wave length

F. Diffusion

G. Ultraviolet radiation

H. Fluorescent illumination

IV. Principles of optical instruments

Units of instruction--7 hours

A. Light rays and beams

B. Reflection of light

1. Diffused
2. Regular
    a. Images
    b. Calculations of angles
    c. Optical levers
        (1) Calculations
        (2) The sextant
3. Curved or spherical mirrors
    a. Real and virtual images
        (1) Concave
        (2) Convex
    b. Calculations
        (1) Image location
        (2) Image magnitude

C. Refraction of light

1. Index
2. Calculations
3. Critical angles
4. Lenses
    a. Types
    b. Terminology
    c. Formation of images
    d. Calculations
        (1) Image location
        (2) Power of lenses
        (3) Image magnitude

D. Dispersion of light

1. The prism
    a. Spectro-colors

        - b. Angles of deviation and dispersion
    - 2. The spectroscope
    - 3. The spectrograph

- E. Polarized light

    - 1. Theory
    - 2. Detection
    - 3. Applications

V. Atomic energy

Units of instruction--5 hours

- A. Nature of atomic energy

    - 1. Early concepts of atomic structure - historical
    - 2. Nineteenth-century discoveries
        - a. Dalton's atomic theory
        - b. Sir William Crookes - cathode rays
        - c. J. J. Thompson - divisibility of atoms
    - 3. Early twentieth-century discoveries
        - a. Robert A. Millikan - measurement of electrons
        - b. E. Goldstein and W. Wien - discovery of protons
        - c. Lord Rutherford and Niels Bohr - planetary concept
        - d. James Chadwick - discovery of neutrons
    - 4. Atomic weight and number
    - 5. Energy in the atom
        - a. Einstein's mass-energy equation
        - b. Law of conservation of mass-energy
        - c. Experiment with lithium
    - 6. Atomic disintegration
    - 7. Atomic bombardment
        - a. Cyclotron
        - b. Van de Graaf generator
        - c. Betatron
    - 8. Uranium fission - slow neutron bombardment
    - 9. Fusion

- B. Atomic energy for military purposes

    - 1. Separation of U^{235} from U^{238}
    - 2. Fissionable plutonium

- C. Industrial uses of atomic energy

    - 1. Plutonium reactor and power developed
    - 2. Radioactive isotopes

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SUGGESTED REFERENCES:

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Hepler, D. E., and P. I. Wallach. *Architecture: Drafting and Design*. New York: McGraw-Hill Book Company, Inc., 1964.

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